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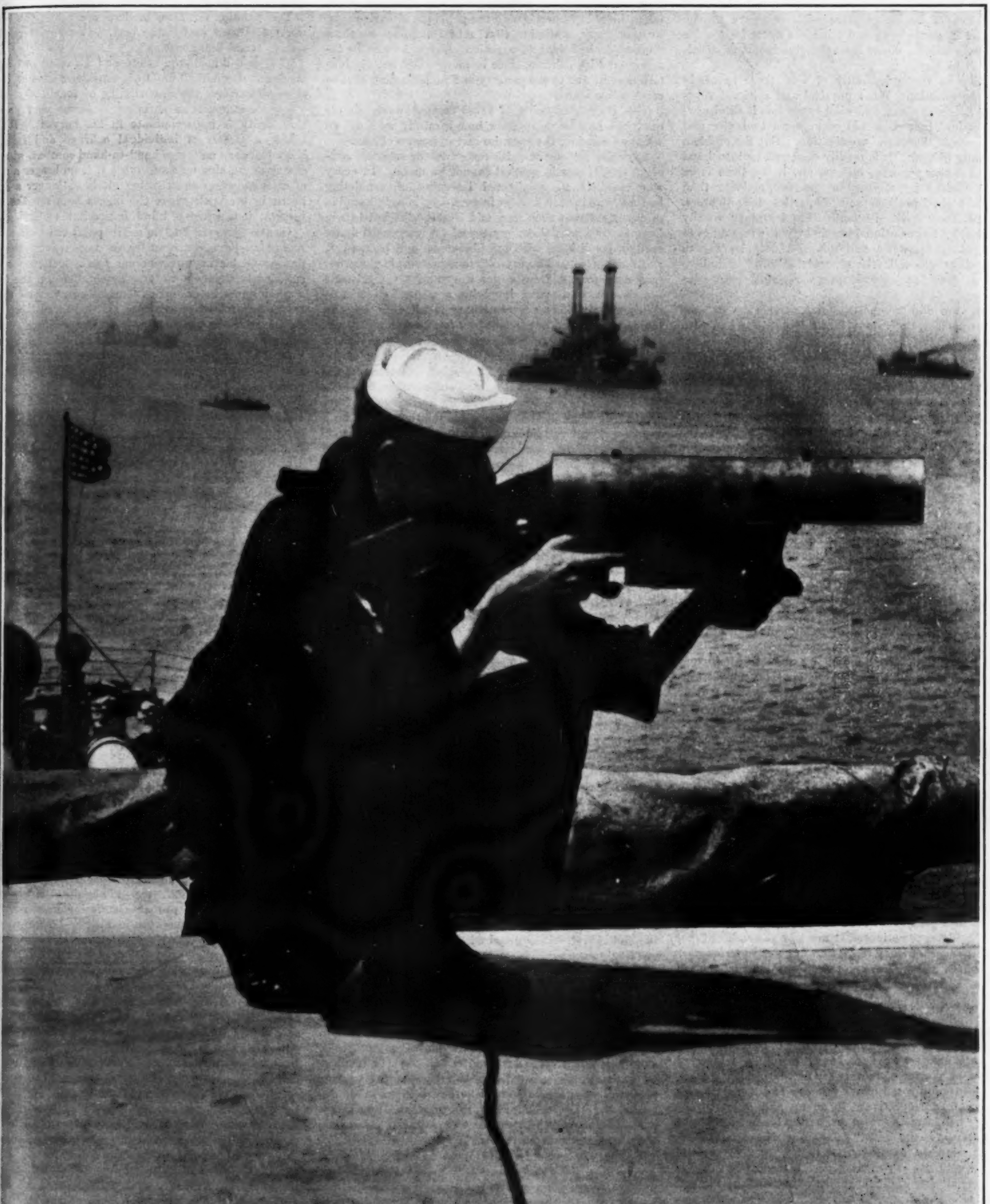


By means of this signal gun a beam of light is flashed only in one direction

SIGNALING BETWEEN SHIPS AT SEA [See page 164]

Some of the Evolutionary Consequences of War*

Influences Unimportant Save That They Result in More Stringent Selection of Women

By Ronald Campbell Macfie, M.A., M.B., C.M., LL.D.

THOUGH war has been in the world since the time of the trilobites, and though its importance in the evolution of animal types has long been a cardinal article in the creed of biologists; yet the sociological and biological significance of human warfare with reference to the evolution of man's body and mind has never been quite adequately studied either from the standpoint of sociology or of biology.

In view of the universality of war, there naturally arises the question: What physical and spiritual types of Man does war select, and what types does it eliminate? No question, indeed, would seem more to invite and more to merit thorough investigation. But the problem is not only difficult: it is readily obscured by associated sentiments and passions, and, so far, it has been more often exploited by military or pacific partisans than elucidated by patient and impartial investigators. Even the wary spirit of scientific inquiry seems readily corrupted by the emotional psychology of war, and even in scientific papers we find doubtful data leading to undoubting generalizations, and strong prejudices drawing, from very weak premises, very wild conclusions.

Thus, we find competent biologists, such as the eminent pacifist, Prof. David Starr Jordan, stating, with reference to the dysgenics of war, that war caused degeneracy in the Romans, and that the Napoleonic wars lopped inches off the stature of the Frenchmen.

Yet both statements, though widely current, have never been proved, and are probably erroneous.

With regard to the Romans. Dr. Otto Seeck, who has made a careful investigation of the subject, comes to the conclusion that the decline of Rome was largely due to political murders and to voluntary enlistment; and such a view is quite as plausible as the view Prof. Jordan prefers. But it might be equally well contended that the fall of Rome was due to malaria, or too much eating, or too many hot baths. We do not know, and we can speculate as much as we please. But we must not use the speculations as corner-stones in any scientific theory of the consequences of war.

We reply to the lopping of the French. It is by no means certain that the modern Frenchman is shorter than the Frenchman of Napoleon's time, and even granting that he is shorter, it would be very difficult to prove that the shortening is the result of war. Further, even if we could prove both propositions, we should still be unwarranted in formulating a general law; for the Teutons who have possibly suffered more from war than any other race in Europe, are a tall race; and the Montenegrins, who have been decimated by war for centuries, are much above ordinary stature; rendering it difficult to believe that they have been pruned by battle.

In old-time wars, when men fought hand to hand with their foes, it is quite possible that the tall strong men, with weight and reach, killed the small weak men—though, even then, brains were of some survival value, and the "race was not always to the swift or the battle to the strong"—and that, therefore, old-time wars led, in some degree, to an increase in the average stature of fighting nations. But it is much less likely that recent wars, waged with modern firearms, picked off the tall so much more frequently than the short as to lead to a permanent reduction in the average height of the belligerent nations. It must be remembered *that the selective agent in most recent wars has been bacteria rather than bullets*, and we have no reason to think that the tall succumbed more readily to disease than the very short.

In any case, it would be extremely difficult to make any permanent alteration in the average stature of any nation of pure or well-mixed race by any process of lethal selection. Variations of stature in the members of any race are, as we now know, mainly a matter of nurture—a matter of mother's milk, oatmeal, fresh air, and so on—and a tall man's progeny and a short man's progeny tend respectively to go up and down to the average height of the race; or, as the biometricians put it, "to revert to the mean." Johannsen, in very interesting experiments, has shown that large pea plants and small pea plants grown from peas of the same pea-pod have equal potentialities; and the individuals, big and small, of a nation are, so to speak, from the same pea-pod, or of the same stock.

A nation like the French, it is true, consists of three distinct races: in the north, the Scandinavian, tall and blonde; in the middle, the Slavonic, medium-sized and dark; and in the south, the Mediterranean, dark and short; and if so be, a large proportion of the two first races happened to be killed off, there might be a permanent reduction in the height of Frenchmen, but even then the women of Scandinavian and Slavonic stock might be able to perpetuate the physique of their races. Further, any statistics that might happen to show diminution in height of a nation after war must be interpreted with caution, since in many cases the diminution may be due to the poverty and underfeeding that so often follow war.

This slight discussion of these comparatively simple questions may serve to show how carefully we must go when we consider the eugenics and dysgenics of war.

Sweeping statements with regard to the selective consequences of war in general cannot be made. In every war there is a complicated interplay of conflicting factors; and in each war the factors vary in weight and in direction, so that each war, and almost each battle, will have its own special consequences. A war waged under modern conditions, with machine-guns, and poison-gas, and serums must be very different in eugenic character and consequences from a war waged with assegais and arrows. A war, again, involving a whole nation must differ greatly in its evolutionary results—social and biological—from a war fought by a few mercenary troops.

Let us, then, consider a special case on its own merits. Let us consider the probable evolutionary effect of the present European war on the biological characters of the English, French, Italian, and Teutonic peoples. (In this inquiry we disregard Russia, for a great part of her huge and very heterogeneous population have been unaffected and will be unaffected by the conflict that is now raging, while the smaller nations pay their own particular tribute to Mars and would require separate consideration.)

In our inquiry we must, in the first place, ask whether the preliminary medical selection of recruits is of evolutionary value.

The nations we have named have sent almost every *fit* man within certain age-limits to fight, and almost every *unfit* man within these ages has been left behind; and a cry goes up from the pacifist and the quasi-scientific and even from the scientific that since the fit go to be killed and since the unfit remain at home to procreate their kind, this preliminary sifting with the temporary procreative advantages it gives to the unfit must, in itself, have evil racial consequences.

It is very doubtful, however, whether this preliminary medical selection can have any important or permanent effects on the future physical fitness of the fighting people. Since I myself have examined and selected some thousands of recruits, I have some special knowledge of the nature of the medical selection, and I would draw attention to the following facts, which seem to have been rather ignored.

The great majority of men rejected, are rejected on account of short-sight, rupture, flat feet, varicose veins, heart disease.

Now, short-sight is very often a product of bad domiciliary conditions; rupture is very often due to accident; flat feet and varicose veins are often the result of too much standing; heart disease is very often caused by rheumatic fever. Most of these defects and diseases are acquired, have no effect on the racial value of the individual—since acquired characters are not immediately transmitted—and are not likely to affect his offspring. Even the men who are rejected for deficient physique are not likely to depress unduly the average physique of coming generations; they are a very small fraction of the total male population; many of them had finished their paternal career before the war; and, in any case, most of them are victims of environment, and their offspring under good conditions will tend, as we have already pointed out, to return to the average physique of the race to which they belong. I doubt, indeed, whether, taking all things together, the average enlisted man has three per cent more racial value than the average unenlisted person.

I cannot, therefore, quite agree with Dr. Abraham Jacobi when he asserts that "the unfit fathers produce unfit children"; I see little reason to fear that the race will suffer from the procreative advantages of the unfit left at home, especially since such advantages have been probably nullified to a great extent by an epidemic of soldier weddings.

Now, let us look at selection in the army by war itself. Armies are not composed, as popular writers assert, of "the flower of the land"; they contain men of all sorts and sizes, sons of Anakim, and bantams—men of 50-inch chests, and men of 32-inch chests—magnificent specimens of humanity, and very feeble creatures—men of keen sight, and men of impaired vision.

The question is: Does modern war select the best or worst of these? and if the best, will the net result be serious racial deterioration?

That is a difficult question, and I should not care to answer it dogmatically. But, considering the nature of modern warfare, the impartiality of machine-guns, the wholesale massacre of shrapnel, it seems very probable that death is indiscriminate in his harvest. It is no longer a matter of individual courage and initiative; it is no longer a matter of hand-to-hand combat, where the strong or cunning man survives; it is no longer a matter of diseases *versus* constitution; it is no longer a case of battle in the open where the bigger men are the better targets; it is a case of blind, indiscriminate slaughter.

On the dysgenic side we might point out that the best regiments have, in most cases, been given the most dangerous tasks; but whether this selection would be sufficiently stringent to have much effect on the race as a whole must be doubtful, especially in view of the fact that many more are wounded and captured than killed. And even if—as we question—modern warfare *do* chiefly kill off the bigger and stronger men, so also do many industrial occupations. The average physique of many great industrial centers is much below that of the general population, and the discrepancy is not wholly nurtural. Weaving machines involving sedentary work, bad air, and meager diet, eliminate the big man much more discriminately than shooting machines: for the big man requires more air and food than he can get. In the United States alone the yearly toll of poverty and preventable diseases amounts to 250,000 dead, and 4,700,000 wounded. The slaying may in some cases be a eugenic process—though in many industries, as we have said, the most fit to survive are certainly not those of best physique—but the wounding is probably much more dysgenic than the wounding of war. So that we reach the curious paradox that war is eugenic in so far as it takes men from the dysgenic industries of peace.

Even apart from industrial selection, physique, *qua physique*, has no particular survival value on the battle-fields of peace. Money is one of the most important weapons of the armies of peace; and selection by gold is at least as dysgenic as selection by lead or steel. A puny millionaire is more likely to survive and propagate his stock than an impecunious Hercules. When we think, too, of the deep-reaching and wide-reaching dysgenic effects of drunkenness and certain racial diseases, we find it difficult to attach great importance to any possible dysgenic selection by war.

On the eugenic side may be counted the good and sufficient food, the open-air life, and the physical training that soldiers enjoy. These tend to improve the soldiers' general health and to diminish their vulnerability to tuberculosis and some other diseases, and many have some actual racial results, since war, through higher wages, with less overcrowding and more food, will also tend to improve the health of the women and the children of the lower classes (This does not apply to Germany, which is probably suffering from insufficient food.) Such improvement in health, however, will be probably quite nullified by greater prevalence of drunkenness, nerve diseases, and vice diseases, and by the greater poverty and destitution that will follow the war.

It is obviously very difficult to estimate the net result of such conflicting factors as we have mentioned; but, altogether, and giving due and full weight to the considerations, that it is only a *part* of the male population (the part between the ages of 19 and 45) who are subject to the direct selection of war; that many of these leave children; that many skilled workmen of war age are shielded in war factories; that all females are unselected by war; that variations in physique, even if selected, are often only nurtural, and that in any case all stocks remain well represented in the survivors—taking everything together, and giving due weight to these special considerations, I think we might be justified in concluding that the present war is unlikely to have any important eugenic or dysgenic effects on the three nations we have under view.

But one very interesting and important eugenic action—an action that has been hitherto strangely overlooked—the war will have.

It will lead to a much more stringent selection of women by men.

*From *Science Progress*.

If men and women are about equal in numbers there is some assortment, but little selection. If there are more men than women there is a selection of men by women. If there are more women than men there will be a selection of women by men. And the greater the disparity in numbers the more stringent will be the selection.

In the case of the four nations under review, there has always been a deficiency of adult males with corresponding selection of females; but, after the war, the deficiency will be much greater, and will lead—especially in view of a probably reduced marriage rate—to a much more stringent selection.

How this fact, and the interest and importance of this fact, have so long escaped scientific notice, it is difficult to understand; but there it is, an unquestionable evolutionary factor.

Such increased stringency, too, of selection of women must in some degree follow every war, so that it is a general law; and it is quite possible that in it may be found the main evolutionary significance and use of war.

I do not for a moment agree with Prof. David Starr Jordan when he asserts that race progress finds its cause in selection only: I believe that there is a *vis a tergo* driving life along certain progressive lines quite apart from selection. But selection plays its part, and no one can doubt the evolutionary value of sexual selection; and war, in this way we have indicated, greatly increases the potency of such selection. If, in the nations we are considering, five million men are killed, that means some millions of women denied motherhood, and a more stringent selection of those chosen to bear children. It is not men the bullets select, but women. War slays men blindly and indiscriminately; there is no racial selection there: the real racial selection is the selection of women made by the eyes and the hearts of the men who survive the war.

Now, on what lines does this selection proceed, and what are its main biological results?

When men have an opportunity to select wives, or when in their hands the choice chiefly lies, there are certain physical characters they usually seek; and these are health, physique, and beauty: for Nature has wisely arranged that men should be attracted by characters that imply capacity for motherhood.

Since health, physique, and beauty are transmitted, it follows that this matrimonial selection favors the evolution of these qualities, and will probably more than compensate for any possible reverse selection by the chances of war.

The upper-class Turks and the upper-class English, who for generations have had the opportunity and have taken the opportunity of selecting healthy and beautiful women, are distinguished for their health, beauty, and physique; and the fine physique and fine features of the Albanians and Montenegrins may perhaps be explained by similar sexual selection.

Anyhow, this selection does take place: it would seem to be the only important evolutionary factor in war so far as the physical characters of the present belligerents are concerned, and to make for health, physique, and beauty.

Health and physique, however, are characters with spiritual consequences, for it is well known that for a *mens sana* a *corpus sanum* is required. It is very possible, too, that the selection will have more specific results than was summarized in the phrase *mens sana*.

Men, select, as we have said, not only health and physique, but also that subtle something called womanly beauty. Now, sense of beauty and craving for beauty are obscure instincts; we do not understand their meaning; but they are also very real and very strong and universal passions, and we cannot doubt that they are factors in the upward moral and biological progress of man, even though we may not subscribe to the dictum: "'Tis eternal law that first in beauty will be first in might."

Of course, there is beauty *and* beauty: the ideal of the Hottentot can hardly be said to make for progress of any kind, and the ideal of the Turk is perhaps largely to blame for the apathy and stupidity of that nation; but I think it will be found that civilized man is inclined more and more to choose such types of female beauty as are correlated with a beautiful mind and with the more feminine virtues of sympathy, unselfishness, gentleness, motherliness. Every war, therefore, will result in a selection that will do something to set up evolutionary tendencies opposite to its own brutal, truculent, anti-social spirit.

Verily it is a fool-proof world!

It is interesting to note, *en passant*, that selection of this nature also makes for the differentiation of nations; for each nation has its own taste in beauty, and this taste, no doubt, has some survival value.

Wisely did Socrates identify the beautiful and the useful, and wisely does William Watson sing:

> "Beauty, the Vision whereunto
> In joy, with pantings from afar,
> Through sound and odor, form and hue,
> And mind, and clay, and worm, and star,
> Now touching goal, now backward hurled
> Toils the indomitable world."

To sum up, then, any influences of the European war on the racial evolution of English, French, and German nations are probably very unimportant, save the racial results produced by the more stringent selection of women which will follow the war as a result of the decimation of men.

"There's a Divinity that shapes our ends, rough-hew them how we will!"

The Great Bell of Moscow*

By W. W. Starmer

> "But who can fathom Heaven's mysterious ways?
> With thy deep tones destined to mix our praise:
> On solemn feasts from high Kremlin's pile
> To call a people to the sacred aisle.
> Alas! condemned, e'en in thy birth, to die,
> And ne'er fulfil thy noble destiny."

This famous bell, written about as one of the wonders of the world, like all things which attain such notoriety has suffered much from incorrect descriptions written by travelers who—while doing their best—possessed insufficient knowledge to deal satisfactorily with its technical details. For the purposes of this article, the particulars as given by Montferrand have been adhered to, as he had special facilities for making accurate measurements when the bell was moved to its present position, being the engineer employed to carry out the work.

The great bell of Moscow is the largest in the world, and was cast in 1733 by order of the Empress Anna Ivanovna to replace a very large bell of the Tsar Alexis Michaelovitch, which was destroyed by fire in 1701.

The original intention was to build a tower on the site of the pit in which the bell was cast. This tower was to communicate with that of Ivan Veliki. Galleries were to be constructed at various heights to form passage-ways between the two buildings, and these would act as ties and add to the stability of the structures.

The project was about to be carried out when a terrible fire (1737) demolished a great part of the city of Moscow, including the wooden erections which had been put up around the great bell. The blazing rafters fell upon the bell and heated the metal to such an extent that the water poured upon the burning timbers reached the bell and cracked it. The piece of casting thus severed weighs about eleven tons.

In 1797 a mechanician neamed Guirt made an at-attempt to raise this colossus; but his plans, though well conceived, were never carried out, as it was thought that in raising it, the bell would break into pieces. Again (in 1819) the raising of the bell was considered, but nothing was done until 1836. By order of the Tsar Nicholas the First, Aug. de Montferrand, an engineer of repute, was given instructions to raise the bell from its pit. The manipulation of such an enormous weight at that period was a problem of great difficulty. It was successfully done by means of twenty capstans, manned by a large number of soldiers, on July 23, 1836. Montferrand gives the following description of the ornamentation on the bell:

Considered as a work of art this bell is remarkable for the beauty of its form and for its bas-reliefs, which are of the schools of Bouchardon and of Coysevox. These bas-reliefs represent portraits at full length and of natural size, although not finished, of the Tsar Alexis Michaelovitch and the Empress Anna Ivanovna. Between these portraits, upon two cartouches surmounted by angels, two inscriptions are indicated, roughly sketched, of which only a few words without connection are legible. The upper part is ornamented by figures representing Our Lord, the Virgin, and the Holy Evangelists. The upper and lower friezes are composed of palms, treated in a broad style and with a great deal of art.

By popular tradition the metal of the bell should contain gold and silver, as it is recorded that rich and devout people threw into the furnace coins, etc., of gold and silver, but an analysis of the metal made at Petrograd at the laboratory of the Corps of Miners shows that the alloy consists of copper and tin in the proportion of 84 to 13, with traces, of zinc, sulphur, etc., 3 per cent. The traces of zinc, sulphur, etc., are no doubt impurities of the metals used to form the alloy.

This analysis does not in any way discredit the tradition that gold and silver coins were thrown into the molten metal, but shows that in the aggregate, the amount of gold and silver—compared with the bulk of the metal—was infinitesimal. Some idea of what would be necessary for gold to show 1 per cent in an analysis of the metal, can be obtained from the fact that gold coins to the value of £300,000 would have had to be thrown into the molten mass.

Gold and silver as component parts of bell-metal have no legitimate place. Gold is about as resonant as lead, and silver as cast-iron.

Copper and tin in the proportion of 13 to 4 is the best alloy known for durability, elasticity and resonance.

All the romantic tales about gold and silver in bells, as component parts of the alloy, must be discredited. There are no authentic analyses of bell-metal—ancient or modern—which show that gold or silver has ever been used as a component part of the alloy.

Tsar Kolokol (king of bells) or Tsarine Kolokol (queen of bells), as this monster is called—is placed on an octagonal pedestal of granite near the tower of Ivan Veliki in the Grand Square of the Kremlin. It is surmounted by a ball on which is a Greek cross of gilded bronze, the total height being 34 feet. On one of the faces of the pedestal is the following inscription cut in Slavonic characters on a marble slab:

THIS BELL,
cast in 1733, under the reign of the Empress
ANNA IVANOVNA,
after having been buried in the earth for more
than a century, was raised to this place
August 4, 1836,
by the will and under the glorious reign of
THE EMPEROR NICHOLAS THE FIRST.

The particulars of the bell, as given by Montfarrand, are: Height, 20 feet 7 inches; diameter, 22 feet 8 inches; and weight, 193 tons.

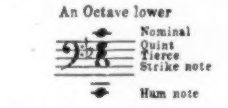
The thickness of the soundbow is given by some as 24 inches, but by others as 23 inches. The latter is likely to be the more correct, for with a diameter of 22 feet, 8 inches it would then be an abnormally thick bell. Montferrand's estimate as to weight is probably much less than the actual weight. It has been computed by other writers, as 185, 200 and 220 tons.

Unfortunately there are no measurements made by an expert available, and to ascertain the correct weight very accurate particulars are essential, but on the figures given by Montferrand a more correct estimate would give the approximate weight as 230 tons.

English bell metal is an alloy of copper and tin in the proportions of 13 to 4. From the analysis quoted, it would seem that in Russia a greater quantity of copper is used to form the alloy.

At current prices the metal of this bell would be worth over £25,000, and to make such a bell (of the finest metal) in this country would cost at least £40,000, exclusive of all the special provisions which would have to be made, such as new furnaces, cranes, tuning machines, etc., and which, together with fittings and framework, would bring the total cost to at least £80,000.

The note the bell should sound would be C, thus:



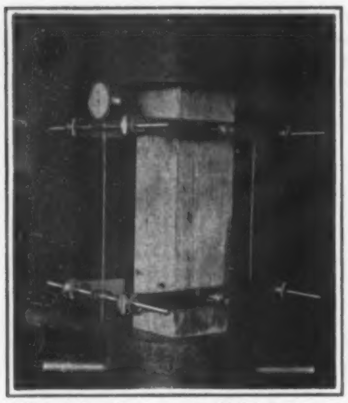
Moscow is, indeed, a city of great bells, for in addition to Tsar Kolokol, and not far from him, there hangs a "live" bell, the reputed weight of which is 110 tons. There are also many other bells of exceptional size and weight.

It was the magnificent and awe-inspiring sounds of these great bells which were uppermost in Tschaikowsky's mind when he wrote the finale of his "1812 Overture."

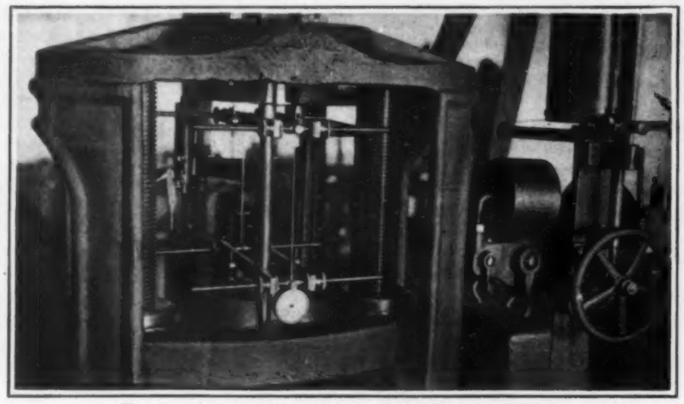
*The London *Musical Times*.

Clock of Precision

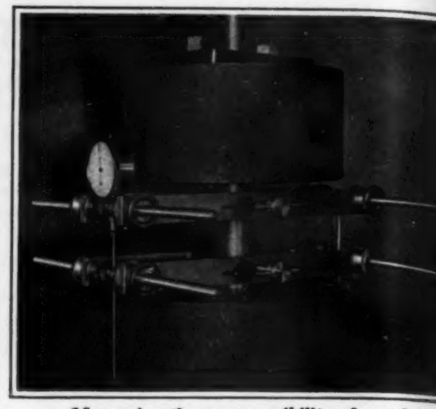
The principal feature of the author's arrangement is the employment of a "slave" clock to do the great part of the work, leaving the master pendulum no function beyond that of controlling the rate of the other. The master pendulum swings freely except for a short period (about 1/5 sec.) every minute, during which it receives an impulse from a small falling wheel electromagnetically released by the salve clock. At the end of its fall the impulse mechanism closes a second circuit and is restored to its initial position. These two electric circuits also energize parts of the mechanism of the slave clock, by which the latter is kept in time with the master pendulum. The lagging of correction behind error, with the resulting periodic fluctuation in the rate, is reduced almost to vanishing point by the introduction of a "negative backlash" in the control mechanism. A mathematical discussion is given of the best working conditions, and of the possible magnitude of errors which might arise from various causes. In the *discussion* C. V. Boys suggested various devices which would attain the same ends as Bartrum's arrangmeent.—Note in *Science Abstracts* on a paper by C. O. Bartrum in *Phys. Soc. Proc.*



Measuring the compressibility of wood



Testing device adjusted for tension measurements



Measuring the compressibility of metal

A Convenient Testing Machine

The accompanying illustrations show a unique form of extension and compression instrument recently described in a paper before the American Society for Testing Materials and Load Deformation Diagrams and curves of tests made with this instrument. Its applicability to a wide range of specimen sizes, either for tension or compression was pointed out was well as the case of use with a satisfactory degree of accuracy and its simple construction and low cost.

It is stated by Prof. S. H. Graf of the School of Engineering and Mechanic Arts of the Oregon Agricultural College at Corvallis, Ore., that the device combines in one instrument all the requirements commonly looked for in several extensometers and compressometers. This universal strainometer is of simple design and consists of two simple adjustable frames, each carrying two screws bearing on the gage marks on the specimen.

One of the frames carries an Ames dial and pivots on a rod held rigidly in the other frame, the dial indicating twice the actual deformation. A toggle clamp prevents the frame from separating from the pivot, and a slender steel rod actuates the staff on the gage head.

The error due to tilting on the dial frame within the range of any test is of no consequence, and within the elastic limit it is not a readable quantity.

The photographs given herewith show the instrument applied to various specimens and indicate its range; this range indicates and includes specimens either in tension or compression up to eight inches in diameter or square, and of any gage length from two inches up. To adapt the instrument to different gage lengths it is only necessary to use pivot and dial rods of different lengths for the ordinary length of specimens, rods of drill steel 1/8 and 1/16 inch in diameter respectively are suitable, while for special tests where the length may be considerable, light wooden strips with steel inserts in the ends are perhaps most satisfactory.

It is claimed that the accuracy and reliability of the Ames dial when applied to strain measurements has been well established, as repeated calibrations of the complete strainometer, as just described, both against a micrometer and against test bars of known modulus, have shown the instrument to be fully as accurate as others designed to read to 0.0001 inch. Some of the extensometers and compressometers on the market, while fundamentally of very precise design, are so complicated and cumbersome as well as slow and difficult to read, that their apparent accuracy as shown by calibration cannot be obtained under operating conditions.

Some objection has been made to instruments having only two (instead of three) points of attachment, but numerous studies made by the means of the Berry strain gage on the distribution of stress in various specimens under tests have convinced the author that under proper conditions of gripping tension specimens and of bedding compression specimens, the two-point instrument will, with equal care in centering, give the average deformation as faithfully as the other.

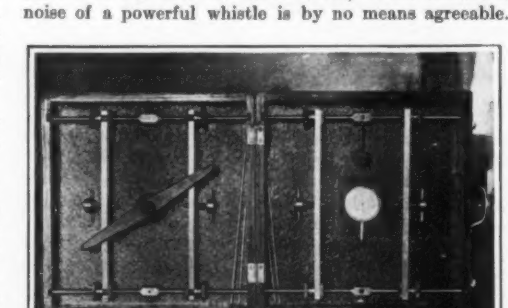
If provided with three dials or micrometers the three-point instrument is useful in showing roughly the distribution of stress, but this makes the instrument too complicated for all ordinary purposes. Three observers would be required if readings were to be taken on the run, and even when load is applied by increments it is difficult for a single observer to read three dials or micrometers accurately. It will be seen that this strainometer embodies a combination of principles previously applied in various other instruments and is of great value in experimental work where the extensometer and compressometer have been utilized in the past.

Signaling Between Ships at Sea

The necessity for a system of signaling between ships at sea has been apparent for centuries, and innumerable schemes have been devised for the purpose. Many of these have now been abandoned, but there is still quite a number of methods in practical use.

One of the earliest signaling devices invented, which was formerly used to a considerable extent on land as well as on the water, is the semaphore. Many different kinds of semaphores have been devised, but the simplest one consists of a post to which two arms are pivoted, and connected with mechanism by which the arms can be set at various angles with the supporting post. By combinations of different positions of the two arms all the letters of the alphabet, and the figures, can be represented, and this device is still used not only on many commercial vessels, but on men-of-war as well.

The steam whistle can also be used to transmit messages, using the Morse code of long and short blasts, but it has not met with much favor, as the continued noise of a powerful whistle is by no means agreeable.



Testing apparatus packed in a case for transportation

The most commonly used system, particularly in the merchant fleets, is what is known as the international flag code, in which 27 flags and pennants, of different designs and colors, are used to represent the alphabet; and there are many combinations of these flags which represent complete phrases or sentences, by which means messages can be transmitted more quickly and easily than if they had to be spelled out letter by letter.

The "wig-wag" system with flags is familiar to most people, as it is extensively employed in military maneuvers. It is used at sea as well, but almost exclusively by war vessels; and in this either one or two flags are used. As a man cannot swing a very large flag in one hand, and as a small flag cannot be readily distinguished at a very great distance, the two-flag system is now little used, and the system employing a single large flag is now most usual.

All of the above mentioned systems are operable only during daylight, and for night work other methods have to be adopted. The simplest night signaling system uses the searchlight, provided with some form of shutter by means of which Morse telegraphic code signals can be flashed directly from one vessel to another, or can be thrown high in the sky so that they can be seen at great distances.

The Ardois system of signal lights is used largely on war vessels, and consists of four or five double electric lanterns located one above the other, high up on a mast. Each of these lanterns is provided with two electric lights, one showing through a red lens, and the other through a white lens. These lights are controlled from a keyboard, by means of which various combinations of lights can be rapidly flashed, and in this way any desired message is quickly transmitted.

Both of these systems have the disadvantage that everyone within sight can read the message, the enemy as well as friends; and to overcome this defect the instrument shown in the illustration on the first page of this issue has been devised. This consists of a light located in a tube, so that it can be seen over only a narrow angle in the direction in which it is pointed, which insures much greater privacy than the other forms of signals. A trigger or push button controls the flashes thrown out by this hand light, which is fashioned after the form of a gun. It is easily held at the shoulder of the signaler like a rifle and sighted on the vessel signaled.

An interesting application of a well known scientific principle has been proposed for these sighting flashlights that is calculated to increase the secrecy in transmitting signals, and this is to polarize the light transmitted. In this condition there is no apparent difference in the light. The party who is to receive the signal is provided with an instrument that also contains a polarizing prism, through which he views the light, and this prism he turns until all the light is cut off. If under these conditions the signaler interposes a plate of quartz in front of his beam of plane polarized light the man at the receiving station sees a flash of light, and by this means messages can be flashed by a beam that is apparently steady to anyone not provided with the necessary receiving apparatus.

There is still another useful means of signaling at sea, either by night or day, and that is the submarine bell, which is located below the surface of the water, and on which signals can be rung that are easily distinguished several miles away by a special form of microphone fixed to the shell of another vessel below the water line. This system, however, is open to the objection that it is as easily heard by everyone within the operating radius as by the one to whom the message is intended.

The light gun shown in the illustration is actually a form of the well-known heliograph, but it has the advantage over the ordinary land types that the beam of light can be maintained in the desired direction on a rough sea, which would not be possible if it were mounted on a stand, as is ordinarily done.

The Constitution of Coal

Based on the experimental results of low-temperature decomposition in a vacuum, the following hypothesis is proposed for the constitution of coal:

All kinds of coal consist of cellulosic degradation products more or less altered by the processes of aging, together with derivatives of resinous substances in different proportions, also more or less altered. These substances are many in number and closely graded into one another in their nature and composition. They all undergo decomposition on moderate heating; some, however, decompose more rapidly than others at the lower temperatures. The less altered cellulosic derivatives decompose more easily than the more altered derivatives and also more easily than the resinous derivatives. The cellulosic derivatives on moderate heating decompose so as to yield water, carbon dioxide, carbon monoxide, and hydrocarbons, giving less of the first three products the more mature and altered they are. The resinous derivatives, on the other hand, decompose on moderate heating so as to yield principally the paraffin hydrocarbons, with probably hydrogen also as a direct decomposition product.

The more mature bituminous coals with good coking properties contain a large percentage of resinous derivatives, and their cellulosic constituents have been highly altered. The younger bituminous and subbituminous coals consist chiefly of cellulosic derivatives much less altered than those in the older coals. They undergo a large amount of decomposition below their fusion point and, partly for that reason, many of them do not coke.—*Technical Paper No. 140*, on "The Primary Volatile Products of the Carbonization of Coal" issued by the U. S. Bureau of Mines.

Old Sundials*

Random Notes Concerning Items of Interest in Various Parts of England

ALWAYS have I loved sundials. They belong to the gardens of old romance; they tell the hours in churchyards, where the hours no longer mean anything at all to the quiet concourse around; they are found on the walls of ancient castles and manor houses; they have no part with modern things, and are ever grave and reverend. Their dissociation from the fitful and strenuous doings of our own age was never so marked as it is now that "daylight saving" has become a feature of summer time. The sundial will not bear false witness. When the sun shines—the only hours when a sundial comes into action—it is no use pretending it to be already afternoon when the shadow cast by the gnomon clearly shows it to be only close upon twelve midday. Such a discrepancy, I have no doubt, gives on many a church tower a flat contradiction to the Act of Parliament, but I personally have noticed but one church where the sundial on one side and the clock dial on the other are so placed that they can both be seen in one glance, telling two tales. This I observed at Berkswell, near Coventry.

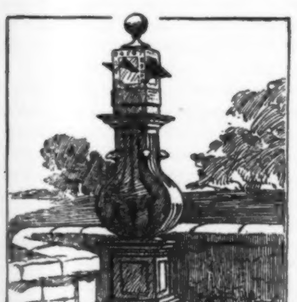
The old time and the new. Sundial and clock in the tower of Berkswell Church, near Coventry, Warwickshire.

The most interesting sundial I ever encountered is that really fine example at Trelleck, near Tintern, in Monmouthshire.

Trelleck is a decayed and forgotten townlet not often visited. There are ancient Roman cinder-heaps there, the remains of extinct iron furnaces; there are medicinal wells, of which no one now partakes; and there is a great grassy mound which some say was the castle mound of a fortress built by the Clares, and some maintain to be the burial mound of the Welsh who fell here in a great battle in which Harold the Saxon was victorious.

Also there are the Three Stones, which are very important indeed. That is why I have reserved them to the last, for they give the place its olden Welsh name—*tri llech*, the Three Stones.

These three monoliths stand in a field near the church, and are thought to be commemorative of Harold's great fight, but they are probably much older.



Sundial on Wilton Bridge, Ross, Herefordshire.

Lastly, there is the sundial; a real beauty. It stands in the garden of the schoolhouse, some eight feet high, and, when last I saw it, was mounted upon an ancient font brought from the church at some former restoration. This sundial was set up by one Lady Maud Probert, who died in 1676. It bears on three of the four sides of its pedestal representations of the great mound, the three big stones and the well, with Latin inscriptions which, being translated, read: "Great in its mound; O! how many are buried here. Greater in its stones; here Harold was victor. Greatest in its springs."

Around the sundial itself runs the inscription, *Eundo hora diem depascit:* "As it goes, so the hour consumes the day."

I am amused, by these old sculptured things, by the figures 8, 10, 14, carved on the representations of the three standing stones, indicating their respective heights and by the two glasses under the carving of the medicinal well, of whose fount no one ever now partakes.

Scarcely less interesting is that old pillar which once stood in the west-central district of London, and gave a name to the once-notorious locality of "Seven Dials."

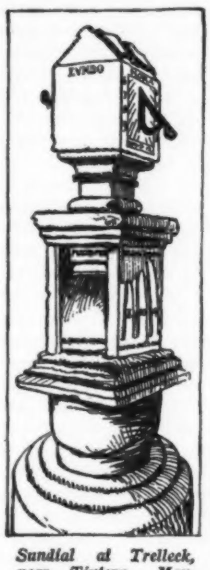
This ornamental column long ago left London for a change of air, and will be found on the picturesque village green at Weybridge, Surrey, an expanse of turf that still commands somewhat rural views, although Weybridge itself has ceased to be anything in the nature of a village.

It was about 1694 that the St. Giles-in-the-Fields region of Holborn began to qualify its name and the builder commenced to plan streets there and make it part of London.

The westerly march of the Metropolis has rendered it impossible to find fields until you have gone another ten miles or so, but as "St. Giles-in-the-Fields" the parish remains, even though the late lamented "St. Giles's Board of Works" and other local entities are swallowed up in the modern "Borough of Holborn."

I do not propose to enter into all the squalid history which has made "St. Giles's" a pseudonym for "misery, hunger, and dirt," as Tom Hood phrased it when seeking a rhyme for "shirt." But it would be interesting to go into the reasons why "St. Giles's and St. James's" have made a popular antithesis in the way of social extremes.

Anyhow, it is quite certain that those who planned St. Giles's did not contemplate creating a slum. No one, I think, has ever done that. Hard by Drury Lane and the Lane of St. Martin, Great St. Andrew Street runs to a point where seven streets radiate. It is a curious, and not admirable, specimen of town planning.



Sundial at Trelleck, near Tintern, Monmouthshire, set up by Lady Probert, who died in 1676.

"Where fam'd St. Giles's ancient limits spread,
An in-rail'd column rears its lofty head;
Here to seven streets seven dials count the day,
And from each other catch the circling ray."

Thus wrote the poet Gay in his "Trivia," but he was inexact. We expect that in poets. He is, however, inexact amid a vast multitude. In point of fact the original plan contemplated only six radiating streets, a seventh—that of Little St. Andrew Street—being afterwards added. But in the meanwhile the column had been set up.

That rather priggish old Evelyn who was contemporary with Pepys wrote in his diary, 1694: "I went to see the building near St. Giles's, where seven streets made a star, from a Doric pillar placed in the center of a circular area, said to be built by Mr. Neale, introducer of the late lotteries, in imitation of those at Venice."

On the summit of this column was placed a large six-sided stone, with a sundial on each of the six sides, corresponding to each one of the originally-intended streets. Hence the popular name of "Seven Dials," which arose—as I think I have now succeeded in demonstrating—from a confusion of thought between the number of streets and the dials facing them, together with the common failing exactly to observe the most familiar every-day object.

And thus the six-dialed "Seven Dials" pillar stood until July, 1773, when it was overthrown by a party of romantic desperadoes who had conceived the quaint notion that treasure was concealed at the base. They excavated it, and found the spot as empty as their own silly heads.

The stones were not replaced, but occupied a neglected corner in a stonemason's yard for many years. In 1822 they were purchased by the villagers of Weybridge, and reërected at Weybridge as a memorial to the Duchess of York, who died at Oatlands in 1820.

Sundial on Maud Heath's Causeway, near Chippenham, Wiltshire.

And there we see the pillar today, surmounted by a crown, instead of the stone of the six dials, which, when last I saw it, was in use as an upping-block for horsemen, in front of the adjoining "Ship" inn.

The holes in the stone, in which the gnomons of the dials had been fixed, were still visible.

Of course, sundials afford the readiest opportunity for displaying the cheapest and most obvious morality. Not very often has the giver of a sundial been able to restrain himself from causing to be carved upon it such admonishing thoughts as "Trifle not. Your Time is short."

The "Seven Dials" pillar, on the village green at Weybridge, Surrey. Inset is a drawing of the original six-sided dial stone.

Fortunately these distressing and ill-natured warnings and truths are generally veiled in the decent obscurity of Latin and Greek, which few other than learned and superior persons of my sort can understand.

I hate that sort of thing. I left a home to which I was dearly attached by every tie because that hymn which tells us we shall all be dead in a few years' time was played daily by a new carillon from the church tower. I do not want to eat that thought daily.

Myself, I do not esteem moral sundial maxims at a great price. As before remarked, they are too obvious. But when they are also ungrammatical then, indeed, is the lesson even more in danger of being lost.

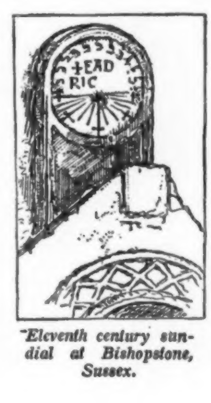
Take, for example, that sundial which stands as part of an oranate pillar on Wilton Bridge, spanning the River Wye at Ross on the Monmouth Road. It is placed in one of the projecting sanctuaries, and has four dial-faces, with the inscription:

"Esteem thy precious time.
Which pass so soon away;
Prepare then for Eternity,
And do not make delay."

Horrible jingle!

There is just as bad to be found on the sundial set beside Maud Heath's Causeway. Some day, when space permits, I will tell you about that famous causeway across the low-lying lands near Chippenham, Wilts., but at present all that can be done is to refer to the pillar there with three dials.

It was erected in 1698 by the trustees, and Latin inscriptions were carved. In 1828 Canon Bowles, of Bremhill, persuaded the then trustees that, as few people could read Latin, these moral sentiments were wasted; and he obtained permission to place his own English renderings beside the originals.



Eleventh century sundial at Bishopstone, Sussex.

On the side facing the rising sun we read:

"VOLAT TEMPUS.
"Oh! early passenger, look up, be wise,
And think how, night and day, Time onward Flies."

Facing noon we read:

"While we have time, do good.
"QUEM TEMPUS HABEMUS, OPEREMUR BONUM.
"Life steals away—this hour, O Man, is lent thee,
Patient to work the work of Him Who sent thee."

So far I do not object very greatly; but the dial turned toward the evening sky, if literally read, is depressing:

"REDIBO. TU NUNQUAM.
"Haste, Traveler! The sun is sinking low;
He shall return again—but NEVER THOU."

I would rewrite that in this automobile age somewhat as follows:

"Tourist, buck up! nor linger long behind,
And light your lamps—lest you perchance be fined."

It is not good poetry, but it is no worse than Canon Bowles's, and it is awfully true.

My friend, the late Sir William Schwenk Gilbert, partner with Sir Arthur Sullivan, had a sundial on the lawn at Grim's Dyke, his place near Harrow. He was visited by many admirers, among them a lady who said she doted on sundials. "*Is* there an inscription on yours?" she asked. "Yes," said Gilbert, "Army and Navy Stores, where I bought it."—WAYFARER.

*From *The Autocar*.

"Soldier's Heart"*

A Misleading Term Applied Indiscriminately to a Variety of Symptoms

By Adolphe Abrahams, M.D. Cantab., M.R.C.P. Lond., Temporary Captain, R.A.M.C., Officer in Charge of Medical Division, the Connaught Hospital, Aldershot

In considering the subject of heart affections as they are encountered in soldiers it will be desirable in the outset to say a few words about the term "soldier's heart," which has now acquired an accepted position in our nomenclature of diseases, one which certainly appears to supply a definite need in corresponding to a definite condition, but, unfortunately, also one which is employed with so much abuse that it is impossible not to regret that such a term should ever have been introduced. We ought to restrict its application to patients who are suffering from cardiac affections, or, at any rate, cardiac symptoms due in some way to military service. In this sense soldier's heart would be an occupation disease, as we speak of miner's nystagmus, scrivener's palsy, or housemaid's knee. But whereas there exists a special group of cases which in my opinion corresponds to such a restriction, even though the exact determining cause is still a subject for contention, the term is applied indiscriminately to a large variety of symptoms which are evident in men who happen to be temporarily khaki-clad and most of which have nothing whatever to do with the heart, nor, for that matter, with military service.

And this reminds me to refer briefly to that question-begging epithet which is so conveniently employed in these days, D.A.H. (disordered action of the heart). Now, whatever words of depreciation may be considered suitable to apply in the case of the aforementioned "soldier's heart" these fade into insignificance when you select those condemnatory enough for its blood-relation D.A.H. I do not hesitate to say that I have seen men complaining of symptoms referable to every disease above the umbilicus sent in as D.A.H., and I am not at all sure that a certain number below this anatomical landmark have not been included. But even if one eliminates those cases of so-called D.A.H. which pass the first portal re-labeled N.Y.D. (not yet diagnosed) and are finally discharged as N.A.D. (no appreciable disease), what exactly does an honest attempt to use the words involve? What precisely is orderly action of the heart and when does chaos ursurp the place of cosmos in the circulatory world? And in the second place is it not absurd at this stage of our knowledge of the etiology of disease to imagine that a diagnosis of tachycardia *is* a diagnosis, or that it is sufficient to say that a pulse is irregular or intermittent without taking the trouble to see what is the nature of the irregularity and if, as a matter of fact, its existence is of the slightest consequence?

In recalling to your memory the copious literature which has already appeared on the subject of "soldier's heart" during the last couple of years, I would suggest to you that a large variety of different conditions have been at various times described as if they were all the same thing. And I think the best way to support this proposition is to enumerate a representative collection of the causes which have been advanced.

First and foremost very naturally is the endeavor to ascribe all cases to exertion. Here, then, is our old friend "strained heart" or "athlete's heart" in modern form. To adapt the condition to military circumstances such features are introduced as marches with weights, shoulder-straps, and the other paraphernalia of service and service kit. The subject of heart-strain I will postpone to consider later in detail.

As a sort of collorary to this school there is another which presupposes the existence of a great deal of latent unsuspected cardiac disease which only manifests itself in consequence of the strain, physical or mental, or both physical and mental, of military life.

To other authorities the condition is due to a toxæmia. If microbic influence is demanded—well, organisms are so easily introduced, from the teeth, for example, or from the food itself, and even if you are deprived of organisms there are always toxins to fall back upon. And if toxins likewise are denied, there are perverted products of metabolism, and some authors blame the excessive protein diet of the soldier.

Another large group of authorities attribute the condition to the thyroid gland. The majority of these think there is hyper-thyroidism, though a few believe the secretion to be normal in quantity, but of pathological quality. The soldier's heart to this school is simply larval Grave's disease.

At least every other week somebody writes to the medical journals explaining "soldier's heart" to be due to excessive cigarette-smoking, and considering the almost universal prevalence of this vice such an opinion has at least the support of reasonableness.

Recently "soldier's heart" has been attributed to deficiency of buffer-salts in the blood, and such an explanation is not without its inconvenience in view of the difficulty in technique in estimating these salts, more especially as I will be impertinent enough to hint that the majority of us are more than vague as to what a buffer-salt is, what it does, and why its absence should produce symptoms of cardiac disease.

One turns next to an entirely different interpretation of "soldier's heart" in introducing the school which supports a psychical origin. Its disciples see no necessity to invoke the existence of any organic pathological cause. In fact, they see no necessity to suppose the existence of any sign of heart disease. They point out that the symptoms, although equally familiar in genuine heart trouble, are quite easily or at least speciously, explainable on a non-organic basis and that a man who has hitherto adapted himself to the most sedentary life, suddenly forced into the activity of unaccustomed exercise, pants and puffs and finds it much easier to sit down than to try to keep going. The symptom of præcordial pain in such cases is generally indigestion due to bad teeth.

Now it seems to me that every one of these explanations is probably right—that is to say, that among the enormous number of cases one meets in the Army with symptoms of breathlessness on exertion, of præcordial pain, and of general so-called cardiac distress there are some which may be explained in every one of these ways. And if I may venture to criticise those of far greater experience to whom we look for guidance, I think they have often made the mistake of laying too much emphasis upon the particular condition they are describing to the exclusion of absolutely all else, and unconsciously, and of course unintentionally, giving the impression that they were dealing with the whole of the cases comprised under "soldier's heart."

I hold the view that the large majority of cases which are labelled "soldier's heart" and condemned as unfit for active service have a perfectly normal myocardium and suffer from symptoms which have no organic basis. I would, then, suggest to you that we may classify the cases which are sent up to us with symptoms or signs which might be referable to the heart in the following way—

1. Functional cases. A large number of men at the outset of their military duties who are free from any organic disease, but who have hitherto been quite unused to any form of exertion and readily display symptoms of distress or of fatigue.

2. Cases with symptoms due to excessive smoking or other drugs and disappearing upon appropriate treatment.

3. Organic disease: (*a*) Valvular disease (1) compensated, (2) uncompensated; (*b*) myocardial disease; (*c*) adherent pericardium; (*d*) Graves's disease.

4. Genuine soldier's heart.

I shall not deal with these groups seriatim, but I shall refer to them indiscriminately in considering general principles.

The first general principle with which we should be concerned is the fundamental question of so-called *over-strain of the heart*. I would mention in passing that Sir Clifford Allbutt points out that this expression is tautological since all strain must be overstrain.

When one has the support of Sir James Mackenzie one need not hesitate to state dogmatically a disbelief in "heart-strain" or "athletic heart." As a matter of fact, on purely empirical and not clinical grounds I never have believed in it; but it is one thing to state what is regarded as a worthless opinion based on inexperience and differing from common acceptation, and another to express a point of view which receives the cachet of the doyen of cardiologists. And Sir James Mackenzie says of "athlete's heart:"

"Personally I have never seen such a thing and, when my opportunities of observation are considered, I think it will be allowed that I would have seen it if it had really existed." He says further: "I have had brought to me great numbers of young people of both sexes with hearts said to have been impaired by overstrain. I have not found a single case of dilatation with heart failure. That dilatation can be produced in a healthy heart as a result of overstrain, more particularly among the young and athletic, is a belief widely held. I am convinced that it is a view which is not justified. I never saw a single individual who suffered from heart dilatation as the result of over-exertion. I think I may fairly say that this was not due to inability to recognize overstrain."

With such a sentiment as the last is there anybody who will disagree?

I cannot lay claim to an experience which would justify me in the presumption of endorsing an opinion of Sir James Mackenzie, but I can at least claim a special experience which is in its way even greater than his. For eight years there has been practically no prominent athlete in any country in Europe (and a good many from the colonies and from America) whom I have not had an opportunity of examining before and after exercise. I have been hunting the "athletic heart" all this time in sprinters, middle-distance runners, Marathon runners, and I have never caught it.

And yet, it will be urged, our eminent predecessors published cases of dilated heart and overstrain which were clearly the result of exertion. In some cases a comparatively recent antecedent infection is definitely stated, in others it is hinted at. And in others, again, a coincidence is well worth noting that both Sir Clifford Allbutt and the late Sir Lauder Brunton describe cases of acute dilation occurring during mountain climbing. Now the physiology of high altitudes is rather queer in itself; a large increase in red corpuscles has been shown to occur, and it is quite possible that by mere mechanical friction they retard circulation to some extent.

A priori there should be no expectation of the heart's failing through pressure of work any more than of a diaphragm becoming fatigued. Nature is not likely to jeopardise the well-being of the most important muscle in the body, but safeguards it by ensuring that everything else shall give in first. When a man is badly done up as the result of a big effort it is not cardiac failure but vaso-motor exhaustion from which he is suffering and his symptoms are due to nothing more serious. Personal experiences, however feeble, have at least a certain peculiar merit which is my excuse for obtruding these. During 16 years of practically continuous competitive athletics I have known frequently what it feels like to be badly run out or rowed out, but I remember only two special instances which stand out prominently. On the first occasion I had won a particularly hard 200-yard race and I can only attribute the nausea, dyspnœa, and dreadful headache from which I suffered the rest of that day as due to an extra effort induced by an exceptional keenness to win. Had I sought advice for my symptoms I might still be in bed or just beginning graduated exercises, but as this was the middle of a big athletic season I determined to adopt the best form of investigation I could think of, and the following morning I went out and ran, with very great relief to my doubts, one of the finest quarter-miles I have ever run. The second occasion was six years ago. Starting from Grindelwald, I went up the Faulhorn and down practically without a stop in four and a half hours. One hour after I had reached the bottom I began to experience intense nausea, and I fainted. I believe that these symptoms were due to the exhaustion from want of food. Once again alarm demanded a critical investigation, and 48 hours later I went up the Faulhorn as hard as I could go; but on this excursion I ate a good déjeuner, and rested for an hour at the top before running down, and I had not the slightest symptom of distress of any kind.

It is easy to understand how soldiers on the march faint, especially in hot weather, when their peripheral vessels are dilated to such an extent as to deplete the brain. Of course, some people are much more liable than others to these attacks from the particular tendency of their blood to drain into the large abdominal veins. Such attacks, too, are largely precipitated by the boredom of a march. The fatigue of disheartenment is a very well-recognized thing.

I put it to you that physical exertion is mainly a matter of will-power. Some men have the will to drive the engine harder than others. But, granting no flaw in the machinery, nobody can drive it to breaking point.

In the consideration of *organic disease of the heart* we have first to deal with the question of *cardiac murmurs*. Sir James Mackenzie says:

"The presence of a murmur is often considered to be inconsistent with the idea of a healthy heart, and the great bulk of the profession and the teachers of the profession do adhere to this view." Further, he says: "Every graduate leaves hospital with but the vaguest notion how to assess the value of a murmur."

*A paper read before the Connaught Hospital Medical Society. Republished from *The Lancet*.

I think I may assert that there is not one of us here who does not almost every day see at least one striking example of the absurdity of worrying about the existence of a murmur qua murmur, a survival of student days when prolonged arguments were wasted upon the exact timing of some miserable squeak, to say nothing of the decision whether there was any murmur there at all. As a consequence we gained the impression from our teachers that the slightest alteration in the character of the heart sounds meant serious organic cardiac mischief, and the fruit of this teaching has been, in civil life, the obstacles placed in the way of such people ever getting insured, and in military life the wholesale rejection of perfectly healthy subjects physically fit for anything; so depriving the country of a number of efficient soldiers, and, what is even worse, condemning to a serious restriction of useful and wholesome activity many men who for the rest of their lives walk about gingerly with the sort of sensation that they have a bomb inside them and with the perpetual dread of sudden death.

Now so long as the heart does its work properly what does a little music in its mechanism matter? Some motor engines purr, others bark, and others roar, yet all may be equally efficient; and the murmur in the heart may bear no more relation to the heart's capacity for work than, to continue the parallel, need a squeak in a spring have anything to do with the engine.

Many murmurs are, of course, not cardiac at all, but due to pressure relations of the pulmonary artery and the chest wall or to some other simple extra-cardiac cause. The distinction of physiological murmurs is usually quite easy if one is not wedded to the idea that heart disease is so common that it must always be suspected. And although organic murmurs must in any case denote a certain degree of disability, even organic murmurs are not necessarily of much consequence. As a convenient rule, Sir James Mackenzie has said that a systolic apical murmur may always be disregarded when there is no sign of enlargement of the heart, for, as he says, "if a murmur is caused by a lesion which embarrasses a chamber in its work, that chamber will alter in form either by dilating or becoming hypertrophied." So that to talk of V.D.H. (valvular disease of the heart) as a definite condition always calling for discharge from the army as permanently unfit is quite unreasonable. To put it in the terms of a common pleasantry, there is V.D.H. *and* V.D.H. The heart's capacity for doing work is the vital criterion, and I am quite sure that many cases of well-marked valvular disease are little, if any, handicapped by their disability.

The heart muscle is, of course, the great factor in cardiac efficiency. If we could always measure the quality of the muscle we should find it easy to estimate the general condition of the heart, and the discovery of myocarditis with corresponding prognosis would be a simple matter. But a person's description of his inability to exert himself is, in my opinion, a very poor guide, although as, you are well aware, more than one cardiologist has stated that we are to accept a complaint of pain, dyspnœa, giddiness, etc., as absolute evidence of cardiac disability, even in the absence of abnormal physical signs in the heart.

As aids in estimating the cardiac efficiency, various tests have been elaborated—*e.g.*, Grapner's; and various instruments have been invented, such as the Bock stethoscope, the application of which has been particularly encouraged of recent date by Dr. O. Leyton. The tests depend upon the differences observed between the pulse-rates and blood pressures in the resting state in the horizontal and erect positions and in the reaction to exercise. The Bock stethoscope is an arrangement which gives a numerical value to the audibility of the first sound at the apex and the second at the aortic base. A heart with normal musculature yields a ratio of 60:40. The nearer the ratio approaches unity the more the myocardium is pathologically affected. We have used the instrument fairly extensively here, and have come to the conclusion that it has a useful application. The chief difficulty in our experience is the necessity for absolute silence during observation, otherwise the error may be so great as to render the result quite useless. The instrument is said to be inapplicable when murmurs are present.

It is unnecessary to deal with the well-known signs of obvious cardiac distress—*e.g.*, cyanosis and œdema. It might be thought that dyspnœa is equally obvious as a sign of cardiac inefficiency, but in this sign there is the possibility of a large functional element. The majority of the ill-fed, flat-chested, poorly developed men who enter the Army after an uneventful sedentary life and are then plunged into what is to them unalluring strenuous activity, naturally puff and blow and complain of pain in the chest. Again, the dyspnœa of what I call a case of real soldier's heart is often an hysterical polypnœa and calls for vigorous physical and mental discipline.

Pain on exertion is, again, a very vague symptom. The pain complained of by false cardiopaths is usually præcordial and not substernal as in true angina, and the pain does not radiate. It often disappears after effective dental treatment, and especially if the man can be persuaded to overcome the inevitable distress of his first exertions and persevere. But once let a man get the idea that he has a weak heart and any hypochondriacal "pain in his heart" speaks to him of sudden death. Speaking generally, we do not think of cardiac disease as associated with pain in the chest and when a man complains thus of his heart one is justified in thinking of his stomach.

It is one of the most important and often one of the most difficult things to decide the meaning of a *cardiac irregularity*. The general tendency is to regard any divergence from a perfectly regular rhythm as evidence of cardiac disease. But, on the contrary, some forms of irregularity are of no pathological importance whatever; indeed, one form, sinus arrhythmia, is even stated to be a particularly good sign that the heart is normal, a sort of hall-mark of a healthy heart. On the other hand, there are types of irregularity which give an absolute indication of serious myocardial change and their determination is far more useful than that of the size of the heart or of any murmur.

Sinus irregularity is a variability in the intervals of diastole. It can be produced in susceptible subjects by stimulating the vagus center, *e. g.*, by swallowing or deep breathing, for it is related to irritability of the center. It can be completely abolished by exertion. Such an irregularity is, as I have said, of no pathological importance.

Extrasystoles, or, as they are more correctly termed, *premature contractions*, are recognized by the circumstance that the "extra beat" anticipates a regular contraction and is followed by a longer pause than after an ordinary beat. It is the long pause which is so unpleasantly apparent to the subject himself. Extrasystoles are often of no pathological consequence, and can be abolished by exercise. On the other hand, they may indicate myocardial disease. They constitute, therefore, one sign only which has to be taken into consideration with all the other cardiac phenomena.

Pulsus alternans is a condition in which alternate beats are of unequal volume. It is a very grave sign of myocardial disease. It is obvious that some care is necessary to distinguish this condition from one in which premature contractions occur after every full beat. In the latter there is always a longer pause after the weaker (the premature) beat. In pulsus alternans the beats are regular and the intervals equal.

Auricular fibrillation is a condition of irregularity in which beats vary in frequency and volume in a completely irregular manner. It is not decreased but generally increased by exercise, and it is a sign of serious organic disease.

Heart-block, in which the rhythm is disturbed at regular intervals by the dropping out of a beat, is always a sign of serious heart disease.

While it is the rarest possible thing for a soldier to be sent us as D.A.H. with *bradycardia*, the number sent up as *tachycardia* far exceeds the total of all the other cases (I mean by tachycardia simply undue acceleration of the rate, while I would remind you that some authorities restrict the term to a special type of acceleration —paroxysmal tachycardia). Now to speak of tachycardia as a distinct condition, when it may be due to such diverse causes as acute peritonitis and drinking too much tea, is as absurd as to label a case abdominal pain when this symptom may be due to indigestion, appendicitis, caries of the spine, pneumonia, or a host of other things. In the first place, some people appear to have a physiological tachycardia and own a heart which runs normally at 110 perhaps and gives rise to no symptoms. When a patient complains of the usual cardiac symptoms it is clearly necessary to exclude all organic causes of tachycardia, *e.g.*, tuberculosis, valvular diseases, myocardial degeneration, adherent pericardium, Graves's disease, and any obvious functional cause, such as excessive smoking. We are then left with a residue of cases about which it seems impossible to decide, in whom there is nothing definitely organic unless you invoke larval Grave's disease. In this type of case there is, of course, no exophthalmos and no enlarged thyroid to aid the diagnosis, but the presence of tachycardia, of tremors, and of nervousness justifies one in diagnosing, according to inclination, larval Graves's disease or a neurotic condition with, as Sir Clifford Allbutt puts it, "a diffuse assemblage of mere accelerations."

And this brings me finally to what I think may legitimately be called *soldier's heart*. I premise as the patient a man who really has been a soldier and exposed to the vicissitudes of warfare. Is the influence of warfare, physical strain, toxin, or psychic trauma? The factor of strain I have done my best to eliminate. A few words will deal with the other possibilities that have been raised. The patient presents symptoms generally of dyspnœa, always of fatigue on slight exertion, lassitude, persistent tachycardia without cardiac enlargement, and perhaps a variable number of neurotic manifestations. There is invariably a history of psychic trauma—it may be one acute occasion or a long-continued bombardment by greater or smaller shocks.

These are the cases for exhaustive investigation, for the detection of toxins, for the estimation of buffer-salts, for the consideration of the balance of the ductless glands, for inquiry into the previous psychical history.

It is unsatisfactory to invoke toxæmia, for surely this factor can never be eliminated and must play a part more or less in the production of any morbid state. The system is probably in a condition of auto-intoxication whenever it falls a victim even to psychic disturbances. In some of these cases the antecedent history clearly exhibits the presence of some infection, *e.g.*, influenza, dysentery, or toxic state, such as constipation or some other cause of auto-intoxication. In other cases it does not.

As regards the ductless glands, I do not see how it is possible to deny or to prove their influence in this condition. What is the effect of their secretions upon the emotions? What is the influence of the emotions upon their secretions? Suppose the psychic disturbance does lead to some alteration in the glands, to the production, for example, of hyperthyroidism. Are we to suppose that such alteration is the principle result of the shock and that treatment directed to the gland will relieve symptoms? I personally have never seen the slightest benefit derived from this or, for that matter, any other form of treatment.

There is, it seems to me, a great deal to be said in favor of a purely nervous origin. In the first place, a very large proportion of sufferers are of a distinct type of mentality, men with shallow reservoirs of nervous energy—the neurasthenic soil, in fact. I yield to nobody in my admiration of the spirit which has animated the majority of sufferers from "soldier's heart" and all other forms of war neurasthenia when I described them in this way. The symptoms correspond to a failure in vaso-motor and cardio-inhibitory control. The obstinate resistance to any form of treatment supports the idea of a nervous origin, a shock to the nerve centers which persists who can say for how long. It is a very striking feature that men who sustain a definite somatic injury do not manifast "soldier's heart," nor any other presumably nervous symptoms. In these cases of injury the immunity of the nerve centers to shock may be explained by the dissipation of the shock elsewhere, as the delicate works of a watch are spared in an accident in which the glass is smashed. It may even be explained without detriment to the hypothesis of neurosis, by the mere circumstance of an injury's having occurred satisfying the subconscious with the realization of something definite, and not presenting to it only the sensation of some vague disturbance, the uncertainity of which prejudices recovery.

Reviewing, with not unnatural pessimism, the persistence of symptoms, one cannot help thinking that only termination of hostilities could cure these suffers, in whom with the best of intentions there must continue to run a subconscious current of defence-neurosis telling them that recovery means a return to the hell from which they have escaped. Treatment of such cases appears to have the sole effect of perpetuating their neurosis by fixation of the attention, although whether immediate vigorous treatment of them as of purely neurotic origin would yield better results we here have no opportunity of observing, since the cases we see are, so to speak, chronics who are left *in* statu quo after a great deal of practically every form of therapy that has been recommended. As we see them, at any rate, such cases are of no further use for general service, but given sedentary work they continue on a low level of activity with the tachycardia and other symptoms unrelieved, but, so far as we can see, executing very light duties with comparative cheerfulness and apparently without any ill effects.

Purifying Asbestos

A WRITER in a German chemical paper says that commercial asbestos, contaminated with iron compounds, may be purified by treatment with a two per cent aqueous solution of oxalic acid for 48 hours, followed by washing with water; the strength of the asbestos is not affected. A band of asbestos, 20 mm. wide, showed at 14 different places an electrical resistance of 600-700 ohms; after treatment as described, the resistance increased to 150,000 ohms. An alternative method consists in heating the asbestos for 20-24 hours in a current of hydrogen or carbon monoxide at 390-400 deg. C. and then washing with very dilute hydrochloric or sulphuric acid and afterwards with water.—*The Engineer.*

A thoroughly bad beginning which means waste and loss from start to finish

The proper way to hang cups resulting in larger product and less injury to the tree

A striking example of dry facing and subsequent fungus attack

Proper Methods of Turpentining

Increased Yield Obtained Without Serious Injury to the Tree

A Letter to the Editor of the Scientific American Supplement, By Eloise Gerry, Microscopist, Forest Products Laboratory

The paper entitled "Gathering Turpentine" by Professor S. J. Record which appeared in the May 19, 1917 issue of the Scientific American Supplement was read by me with great interest. There is certainly a crying need for less wasteful methods, especially in the obtaining of the raw product, or oleoresin from pine trees of the South. As a result of considerable recent study of this problem, made through the Forest Products Laboratory of the Forest Service, U. S. Dept. Agriculture, much of which has been carried on in the forest, I take the liberty of submitting to you certain points which supplement some of the excellent suggestions made and which in a few cases contradict statements which Professor Record has cited from some of the previous publications on this subject.

To secure the best yields sharp tools should always be used, and a clean, smooth streak cut.

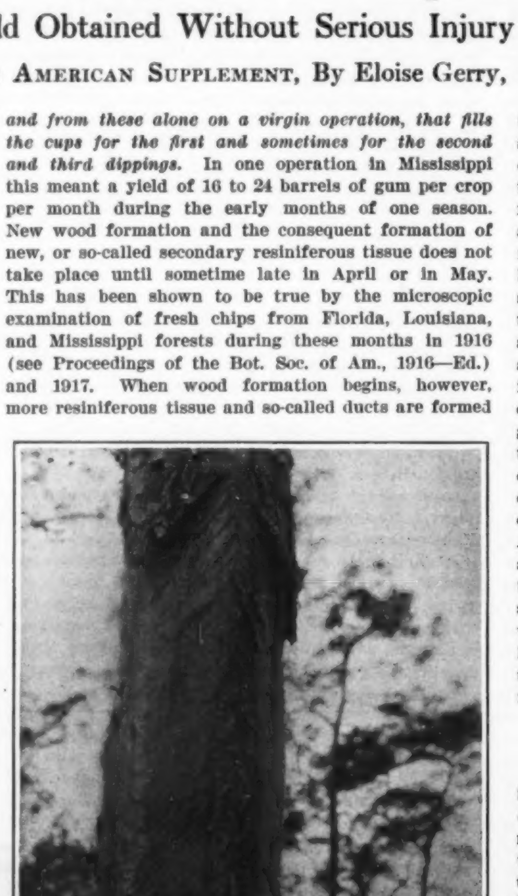
It is desirable to dip very regularly. If a chipping of one streak per week is the rule, chip the same group of trees, or drifts, each Monday; the adjoining drifts each Tuesday; that is, do not permit the chipper to leave until Wednesday or Thursday the trees which he chipped on Monday the week before.

Paddles to cover the gum cups should be carried by all chippers using hacks and these, or chip catchers on pullers should always be used to keep the gum in the cups free from bark and chips which lower the grade of the rosin.

Frequent dipping produces a higher yield of turpentine since less is lost by evaporation.

One of the most fundamental and significant causes of waste is the careless placing of the faces on the trees. This can be seen on practically any operation; that is, faces are frequently cut so that sooner or later they run together and the "bark bars" between them are destroyed so that a reduction in yield or dry facing results. A striking illustration of this appears in the accompanying pictures. Often such a condition does not occur until the second or third year of an operation. Whenever it is found it means waste in every step of the operation for it costs as much to lease, chip, and dip poorly-yielding trees as good ones. Besides, such careless operations frequently kill the trees, thus making them subject to the attack of insects and fungus which reduces the value of the lumber, causing an entirely preventable waste.

The cutting of an "advance streak" the full width of the face at the time the gutters or aprons are hung in the winter is urged, but not for the reasons cited by Professor Record. It is true that "wounding such as chipping, stimulates the vital processes at the seat of injury (if that is the outer sapwood—E. G.) and greatly increases the by-product resin." This is the first advantage of the advance streak. It stimulates the ducts already present in the wood to increased resin production, and *it is the yield from these ducts, and from these alone on a virgin operation, that fills the cups for the first and sometimes for the second and third dippings.* In one operation in Mississippi this meant a yield of 16 to 24 barrels of gum per crop per month during the early months of one season. New wood formation and the consequent formation of new, or so-called secondary resiniferous tissue does not take place until sometime late in April or in May. This has been shown to be true by the microscopic examination of fresh chips from Florida, Louisiana, and Mississippi forests during these months in 1916 (see Proceedings of the Bot. Soc. of Am., 1916—Ed.) and 1917. When wood formation begins, however, more resiniferous tissue and so-called ducts are formed than are normally present. After their formation sometime in May, these greatly augment the total yield of oleoresin but in conservatively operated healthy timber a considerable amount of gum is also obtained from highly stimulated resiniferous tissue which was already present in the outermost sapwood rings of the round timber before it was chipped. It should be borne in mind that this does not mean that timber should be chipped so deeply that the sapwood is cut through to the heartwood. It is most important that a layer of living sapwood be maintained in as healthy a condition as possible behind each face. If the scrape is removed with each chipping there tends, at the end of the season, to be a sufficient coating of hardened gum on the face to function as a protective coating, thus preventing to some extent the undue drying out of the face from exposure to the wind. The depth of the chipping must be governed by the width and character of the sapwood and the vitality of the tree. As regards the height of chipping, it is not advisable, all things considered, to advance up the tree faster than one-half inch per week, or about 16 inches per season. Experiments are now under way to determine whether the height of chip may be further reduced. Experiments in applying French methods to American timber in Florida are also yielding very interesting results.



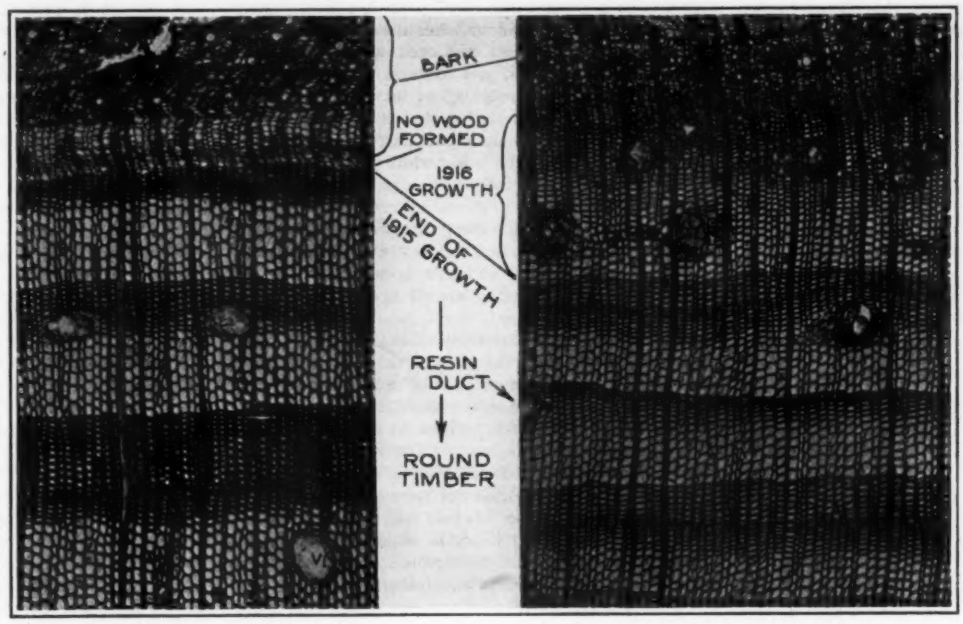
Gradual destruction of bark from too severe chipping. About one third of the trees on such an operation die

Salad Oil from Fruit Seeds

As every one knows, the kernels of the seeds of stone-fruits, such as the peach, the plum, the apricot, and the cherry are rich in oil. But there have existed until recently serious practical obstacles in the way of obtaining this readily and economically. These were the difficulty of cracking the stones without crushing the kernel, and separating the kernel from the shells. It was announced recently however, that once more the mother of invention, stern necessity, has given birth in Germany to a new offspring for this special purpose.

A perfect nut-cracking machine has been invented, according to the *Bulletin* of the National Institute of Agriculture, and at the same time an admirable method has been devised for the rapid separation of the shells from the kernels.

This is based upon the fact that there is a difference in the density in the two, that of the kernels being 1.05 and that of the shells about 1.18. The mixture of shells and kernels is thrown into a solution of calcium chloride or magnesium chloride having a density of 1.15. Therefrom the shells sink to the bottom while the kernels float on top. The latter are then washed and dried and subjected to pressure to extract the oil. This is somewhat cloudy, but soon clears. Its taste is agreeable at first and then becomes somewhat bitter, recalling that of bitter almonds. However, this odor is easily removed either by aeration or by heating to 160° C.



Cut April 15, 1916. Same condition noted as late as May 8, 1917. No wood formation has taken place

Shows amount of wood formation July 5, 1916. Note increased number of resin ducts, 4 to 8 times normal number

Cross-section of about ⅛-inch of wood next the bark at the streak on long leaf pine, Virginia operation

Bread and Flour*

By Sir Francis Fox, M.Inst.C.E.

BREAD, we are told, is the staff of life; it should not therefore, be a waste of our time to try to learn what is known of it, and of the wheat and flour which are to make it. And yet, although we all live more or less by bread, there is hardly any subject upon which the ordinary public are more profoundly ignorant.

According to the returns of the Board of Trade, bread and flour constitute nearly half of the laboring man's solid food, and almost the sole diet of many poor children, and it is therefore most important, from a national point of view, that each of these commodities should be produced, and that the public should know and ensure that they are produced, in as pure and nutritious a form as possible. It was with this aim that the Assize of Bread was instituted at an early age, and in the year 1202 a proclamation was made for regulating the quality and price of bread. Four "discreet" men were appointed to carry out the provisions of this law, and the pillory and tumbril were the punishments awarded to those who broke or evaded it. It is to be feared that, were the Assize of Bread still in force, the modern system of flour-milling would to some extent infringe the enactments, and render some of our millers liable to its penalties.

Let us first briefly consider the growth and production of the cereal wheat, and notice some of the peculiarities attaching to it.

It is a tender annual requiring constant attention, and if left uncared for, and uncultivated, dies out. For instance, let a field be sown with wheat and then let it be neglected; the wheat plant will grow up and shed its grain, and this may possibly survive a mild winter, but in the course of two or three years there will be no trace left of the crop nor of the plant. Very different is this from the herbage for cattle, which grows everywhere unasked, and which covers very quickly any waste ground. Again, it is not only a tender annual, but it is remarkable for the very wide range of latitude in which it will grow. It is cultivated in the hot plains of India; it grows in the cold of Siberia, and even within two hundred and fifty miles of Klondike. It is believed there is no other plant which is adapted to such great changes.

Wheat requires the ground to be prepared for it, thus involving an enormous amount of labor. To till even one acre with furrows 12 in. apart compels the ploughman with his plough and team to travel eight miles and a half; if the field be fifty acres in area, it entails a journey of 425 miles. The grain has then to be drilled into the soil, and the field has to be rolled and harrowed. When the time of harvest arrives it has to be reaped, gathered and stored, threshed, and ground into flour. Finally it has to be baked and made into bread to gladden the heart of man. We are told that "In the sweat of thy face shalt thou eat bread," and this is strictly and literally true.

It is noticeable that the value of a crop of wheat depends, not only upon the quality and quantity of the grain, but also to some extent upon the crisp, bright, glassy character of the straw. The straw-hat trade of Luton and Dunstable, and other places in the neighborhood, depend upon the fact that the straw used for plaiting is grown on adjacent chalk land. The plant has great affinity for the silica in the chalk and flints, and uses it for coating the outside of the stalk with that beautiful glass-pipe covering. And it is due to this fact that America, although she grows such enormous quantities of wheat upon her alluvial lands (having no chalk land), has to send to England for straw, through which her people consume their iced drinks, the straw being stiff and airtight, and therefore more suitable for the purpose than their own.

Let us next consider the constituents of a single grain of wheat—the fruit of the wheat plant—the principal and all-important ingredient in every loaf of bread. If a grain of wheat be cut in half and examined under a microscope, it will be found that beneath the outer covering which constitutes the bran and "sharps" there are two divisions. The larger one of these contains the white substance or flour, and the smaller, the germ or embryo of the future plant. It is the germ that provides in great measure the color, the flavor, and the nourishment of the wheat. It is rich in proteid and fat, and its presence or absence in the flour makes a great difference between bread which is palatable and nutritious and that which is tasteless and to many unacceptable.

From the earliest ages until comparatively modern times, our ancestors had the wisdom so to grind the grain that the resulting flour contained the white substance as well as the nutritious elements of the germ. To this end they employed horizontal running stones —the upper and nether mill-stones of the Bible. From these issued a flour, wholesome and full of nutriment, but in color, owing to the golden tinge of the seed-germ contained in it, not a dead white. This was the flour which for centuries went to make the good old-fashioned home-made bread which our ancestors used, and which went to make our ancestors what they were.

Many of us can remember the introduction about forty to fifty years ago of "Pure White Hungarian Flour," and how it originated the demand, first of our housekeepers and cooks, and afterwards of our working-classes, for white bread. To enable the baker to supply this very white bread to the public, it became necessary for the miller to supply white flour. This could not be achieved by the use of the old-fashioned horizontal grindstones, which by disintegrating the germ tinted the flour. It became obvious to the miller that, to produce the white flour demanded, the coloring germ must be eliminated from it, and this he has succeeded in doing most effectually. The old upper and nether stones are put on one side, and for the production of white flour steel roller-mills are substituted. The first pair of steel rollers do not grind the berry; their mission is to crack the wheat and then to roll the germ into little discs, which do not go to make the flour at all, but are sifted out from the flour by sieves of silk. The result is that the public have achieved the white or anæmic loaf, but, in doing so, they have lost the best of the nutritive element of bread. The little discs of nutriment are used for various purposes, being bought, in some cases, by certain patent bread companies, but the bulk going to feed pigs and cattle, while our children are being regaled upon the less nutritious white loaf.

The writer recently visited some flour-mills in which one part was still using the old-fashioned stones, the other portion of the establishment being devoted to roller-grinding. The official in charge of the former said that he considered that roller-grinding and abstraction of the germ ought to be prohibited by Act of Parliament. On visiting the roller-mill, the foreman of that department, being asked what advantages accrued from roller-grinding, replied, "It makes such superior flour." To the question what he meant by superior flour, he answered, "It is much whiter." He was next asked which was the more nutritious. "That," said he, "is quite another matter." The discussion was finally clinched by the question upon which flour he fed his family, and his reply was an eloquent testimony as to the pernicious character of the entire system, for he said, "I feed them upon stone-ground flour."

Bread made from flour which contains the germ is far more palatable and pleasant and will remain fresh for days. Such a loaf, after being kept for a fortnight, was found to be perfectly suitable for eating, for although dry on the outside, it was moist inside even after that length of time. Much of the roller-ground flour, on the contrary, makes bread which crumbles like sawdust within a few hours, is tasteless, produces with many indigestion, and gives but little satisfaction in any way, Minnesota and Cambridge digestion experiments notwithstanding.

The objection has been raised that the germ renders flour rancid if kept for long; on the other hand, leading millers not only deny this, but say that flour, with the germ, will keep longer than without it. Prior to the introduction of roller flour, passenger steamers between England and India carried their supply of flour for both voyages with complete success, until this was prohibited by the Board of Trade on account of its not being snow-white.

I was told only a week ago by one of the Government Departments that flour sent to the Belgian Congo kept better if the germ were left in than that from which it had been extracted.

The reckless pursuit of cheap wheat under the operation of Free Trade has brought us to the dearest bread that anyone can remember, and within sight of the possibility of no bread at all.

Thanks, however, to the war, the grave error of all previous Governments—of both parties—who neglected agriculture has been brought home to the nation in a manner which no amount of discussion would have accomplished. The cry of "back to the land" is heard on all sides, and, thanks to a better wage being fixed and a better price for grain being ensured, we shall doubtless make great progress towards rendering the country more self-contained.

The material which is separated from flour is termed by millers *offal*, which is a wrongly applied word, and one much to be regretted, as it conveys to the minds of people exactly the converse of the fact. According to the dictionaries, offal means, "the rejected or waste parts of a slaughtered animal, a dead body, carrion, that which is thrown away as worthless or unfit for use, refuse, rubbish." So far from this being the case with that which is abstracted from flour, it constitutes the richest, the most valuable, and most nutritious portion of the grain. Then, by additional grindings and siftings, the superfine white flour is produced. It contains less percentage of the original wheat (probably 68 to 72), requires more costly machinery and more elaborate processes, and when finished is a more expensive and less desirable product.

It is an interesting fact that the evils of roller-grinding were predicted by Mr. Stephen H. Terry in a letter written to the *Lancet* so long ago as June 10th, 1882.

I cannot do better than quote his letter, from which it will be seen that Mr. Terry was one of the first, if not the very first, to call public attention to the pernicious grinding of snow-white flour:—

"SIR,—The sciences of Medecine and Engineering go hand in hand in matters connected with the sanitation of dwellings. I think they may also work together in the preparation of food supplies. At a meeting of the Institution of Civil Engineers, held on Tuesday, May 16th, three papers were read by Messrs. Baker, Simon and Harding, dealing with improved methods of preparing flour from corn, the objects of these methods being to produce by means of roller mills the largest bulk of white flour from a given quantity of corn, and to separate entirely, by silk-gauze dressing machinery, all bran, pollard, sharps, and toppings from the flour, thus producing a flour of almost perfect purity and of dazzling whiteness, for which there is, unfortunately, a growing demand in this country. Now, it is well

*Abstract of a paper read before the Royal Society of Arts, and published in the Journal of the Society.

known to chemists and medical men, though not to the general public, that such flour, while it has lost the rough exterior, the first coating of bran, containing silica, has also parted with nearly all of the second, third, and fourth coatings, containing as they do nitrogenous substances, phosphates, and other salts, which are so necessary for the formation of bone, teeth, and muscle. * * *

"The system of high-grinding has been in use to a considerable extent in Hungary for some years, but the absence of bran in the Austrian and Hungarian white bread is made up for by the large consumption of rye-bread, which is eaten by all classes, and is not confined in its use to the poor, as many people erroneously imagine. The following tables show very clearly how large a proportion of valuable bone-forming material

COMPOSITION OF FLOUR AND BRAN FROM PELIGOT AND BIBRO.

(The figures are the means of fourteen analyses.)*

		Parts in 100.	
		Flour.	Bran.
Water		14·0	10·3
Fatty Matters		1·2	2·82
Nitrogenous Substances insoluble in water	Gluton	12·8	10·84
Nitrogenous Substances soluble in water.	Albumen	1·8	1·64
Iron-Nitrogenous soluble Substances	Dextrine Sugar	7·2	5·8
Starch		59·7	22·62
Cellulose †		1·7	43·46
Salts (Phosphates), etc.		1·6	2·52
		100	100

* Parkes' "Hygiene," Fifth Edition, page 222.

† The cellulose named above is that of the entire grain cells and all (husk and interior). Potash, phosphoric acid, with magnesia, are the principal salts.

is lost by complete separation of the bran, even under the old system of milling; while by the Hungarian system the bran is squeezed between the rollers and parts with all the adherent flour, the bran remains entire, none is ground into small particles, consequently none remains with the flour after dressing, and chemical analysis of flour so produced would be almost entirely free from salts, and contains less nitrogenous substance than the samples given in the tables."

I think I am safe in saying that the best flour can be produced with less than one half the number of rollers required for the snow-white flour, and this ought to result both in increased output and in reduced cost.

There is no doubt, however, that stone-ground flour possesses a creaminess and nutty flavor which cannot be imparted by rollers, and this is believed to result from the degree of heat produced by the friction between the stones.

I recently called the attention of the Board of Trade, the Local Government Board, and the Board of Agriculture to the great importance of increasing the percentage of flour from a given quantity of wheat, and the following figures will appeal to all: 100 tons of wheat produce about 70 tons of the very white flour; 100 tons of wheat produce 86 tons of the desired flour, thus saving 25 per cent. of the necessary freight; 100 tons of wheat produce 99 tons of wholemeal flour, which, if finely ground to an impalpable powder, produces the richest and most nutritious flour: this represents a saving of 41 per cent. of the freight.

We need have no fear of our bread if even barley and rye be mixed in suitable proportions with wheat flour. Now that the Government is taking over the flour-mills of the country it can insist upon a proper mixture, and the necessary uniformity of the product. Many of us are acquainted with certain Continental breads of these admixtures, and are aware of their excellence, and we read of "the five barley loaves and two fishes." Whenever I travel in foreign countries, instead of using the fancy and white breads usually supplied to hotel guests, I invariably endeavor to purchase the bread made by the peasantry and for the working classes, as being more nutritious and much more pleasant to the taste.

Now we come to these war days, when it has been found necessary to interfere with the milling. The first decision was to prohibit absolutely the very white, or 70 per cent flour, and this great improvement would never have come about had the war not taken place, for we are, or have been, absurdly conservative in many ways.

It is rumored that the germ is still being extracted. This should be prohibited as it materially diminishes the food value of the flour.

Some of the strongest opponents in this crusade for better bread have been our milling friends, who now congratulate us on having attained what we have been struggling for, and they add, that "the recent bread is much more palatable."

This results in great measure from the germ being retained, and although the percentage is only 1½, the potent influence does not depend on its weight. Probably it can in some way compare with the influence of "enzymes" and "vitamines" which, although invisible and almost imponderable, nevertheless are very important factors in the value of various foods.

It has recently been discovered that the vitamines are chiefly in the germ and the outer part of the grain, the very parts which, by roller-milling, are romoved in producing white flour. This no doubt explains why this material is not so nourishing as 81 per cent. flour. The children of the poor, fed on white bread, jam and tea, are ill-nourished and sickly.

Under the new Orders of Lord Davenport of January 29th, March 12th, and April 4th last, every miller is required to increase the percentage by not less than 5, bringing it up to 81 per cent, on the schedule, either by a further milling and extraction of flour from the wheat, or by the addition of flour derived from barley, maize, semolina, rice or oats, of not less than 10 per cent., or, at his option, of not more than 25 per cent.

A system of spraying wheat, known as the "Loring system" facetiously described by a leading baker as the loading system, has recently been introduced, and although certain high authorities state that this does not add to the weight, equally high authorities distinctly say that this is not only incorrect, but that it is unfair to honest millers and to the consumers, and that it is against the interest of British wheat. Upon this subject I do not attempt to express an opinion, but it should be carefully investigated and discussed. Five years ago people would have been prosecuted for adulterating bread. To-day they will be prosecuted if they do not do so.

I am of the opinion that the public are indebted to the bread reformers for having exposed the pernicious practices of bleaching flour—of extracting the germ; and also of the polishing of rice and pearl barley. Beri-beri resulting from polished rice was first discovered at Rangoon and this alone is a full justification for prohibiting rice puddings made of polished rice.

Marine Salvage Operations*

By Robert Wright

WHEN anyone wishes to know how a vessel is designed, constructed, or navigated, plenty of books by the best authorities on each of these particular subjects can be got, but when an unfortunate vessel becomes a wreck the knowledge of the methods by which the salvage officer recovers and restores her to her former useful sphere is singularly meagre.

The duties of a marine salvage officer are often of a most difficult and onerous nature. He must be able to estimate approximately the weight, buoyancy, trim, and stability of a ship in her damaged condition, quick to form a plan of operations, taking into account the position of the vessel, the nature and extent of the damage she may have sustained, and the character of the plant at his disposal. While it is very seldom that any two cases he may be called upon to handle will be alike, still marine salvage operations may be divided into two groups, viz., "Submerged vessels" and "Stranded vessels."

Let us consider in the first instance the case of a vessel sunk in deep water that is entirely submerged at all states of the tide. Before any decision can be arrived at regarding the method by which the vessel is to be raised, it will be necessary to send a diver down to examine and report on her condition. The modern diving gear is fairly familiar to those who have to do with the sea and ships, but as it—more than any other invention—has made possible the salvage of ships sunk in deep water a few descriptive remarks regarding the development of the same may not be out of place. The first really practicable diving bell was invented by Dr. Halley, Secretary to the Royal Society, and described by him in the Philosophical Transactions of 1717. It was constructed of wood covered with lead, and shaped in the form of a truncated cone. Air was supplied by two small barrels which were alternately lowered and raised as quickly as possible. A most important improvement on Halley's Bell was made by Smeaton in 1778, he having substituted force pumps for the imperfect method of obtaining air formerly in use.

* A paper read before the British Institute of Marine Engineers.

Kleingert's dress invented at Breslau in the year 1798 was actually a small diving bell, enclosing the head and body to the waist and having holes through which the arms were thrust.

Siebe's open dress invented in 1819 was the next step in advance. It consisted of a helmet and waterproof blouse extending to the waist. The air pumped in at the helmet escaped at the bottom of this garment and thus the dress was termed open. Although a great improvement, this dress had one serious defect. It was necessary for the diver always to maintain a nearly upright position, because if he went down and brought the helmet to nearly on a level with the bottom of the open blouse the air escaped so rapidly that he was in danger of being drowned, and to correct this defect the present form of close dress was introduced in the year 1837. The outfit consists essentially of an air pump, generally treble barrelled, and fitted with a dial pressure gauge for indicating the pressure required at any depth up to 200 feet, the whole being enclosed in a strong wooden box.

The helmet is made of copper, tinned inside, and is fitted with three glass eyes, the front one being arranged to unscrew. The air tube coming from above passes under the diver's left arm and is connected with a union joint at the back of the helmet. A non-return valve is fitted here so that should the air tube be cut by accident, the passage is at once closed and sufficient air is generally contained in the body of the dress to allow the diver time to signal to be drawn up. The air as it enters the helmet is conducted into three flat passages which cross over and terminate just above the glasses inside so that a thin stream of pure air is continually removing the condensed breath and keeping them transparent. The outlet valve by which the air escapes is placed at the side of the helmet towards the back and is perfectly self-acting. In addition to the water pressure a small metal spring is fitted which bears the valve down on its seating, and the force exerted by this spring can be varied by a screw regulator. The helmet is secured by a segmental screw to the shoulder piece or corselet, which is fastened to a waterproof dress made of double-tanned twill, with india-rubber between.

Were the diver to attempt to descend without being specially weighted he would probably come to the surface feet uppermost, therefore in order to enable him to sink and maintain a vertical position he is provided with front and back weights and the sole of each boot is formed of lead. When ready to descend the diver carries a total weight of about 170 lbs., and a man who can work at a depth of 120 feet may be considered fully qualified physically. During his descent the diver must go down gradually as he passes through a range of pressures varying with each foot of submergence, and the air supplied to him must be compressed so as to equal the hydrostatic pressure at the particular depth.

When he is ascending, particularly from depths of over 15 fathoms, great care must be exercised, otherwise he may develop serious symptoms. The greater the depth at which the man has been working and the longer the time he has been submerged, the greater is the danger of returning to the surface without allowing the body to adjust itself gradually to the altered conditions.

Diving operations are usually conducted from a surface boat subject to all the influences of wind, waves and tides, and a line with knots at regular intervals is lowered to the bed of the sea. Clinging to this line an expert may by regulating his air valves, inflate or deflate his dress so that the volume of water displaced at any given depth is equivalent to his total weight and by so doing descend or ascend at a rate which allows the pressure on his body to be increased or decreased gradually. Some misconception seems to exist regarding the depth to which a diver can safely descend. With the ordinary equipment at present available the utmost depth attainable appears to be about 35 fathoms (210 feet). Several forms of diving dress have been invented to enable the diver to withstand the pressure due to greater depths, but so far, these have only proved useful for such simple operations as pearl gathering, etc.

The methods generally adopted for raising wrecks sunk in deep water may be classified as pontooning, pumping, and air pressure. Pontooning is the name generally given to that system of raising wrecks by which pontoons or barges having the necessary buoyancy, lift the sunken vessel by means of chains or wire

ropes passed under her. This method is an old and well-tried one, and for vessels up to 2,000 tons sunk in over 30 feet of water is one of the safest and most certain plans that could be adopted. The barges employed should be strongly built and when carrying the weight of the wreck should have at least 25 per cent. reserve buoyancy to allow for contingencies. When a salvage officer decides to pontoon a vessel he has generally to take whatever barges or old vessels he can find handiest and nearest the scene of operations. Improvised plant of this kind adds greatly to the difficulties to be encountered, because it is necessary when taking in and making fast the lifting cables to have each one carrying its proper proportion of the weight, and without suitable appliances this is not easily arranged.

Should the wreck be lying on a soft bottom the cables or ropes are generally passed under her to the position required by being drawn back and forward with two tugs working with a sawing movement. If on a rocky bottom the divers go down with a long slender rod to one end of which is attached a light chain, this they pass under her wherever practicable, and by means of the small chain the larger cable or wire can be pulled through, the ends are then buoyed up till required. When all is ready they are taken in and made fast at low water. The tide on rising lifts the wreck through the buoyancy of the pontoons and it is then towed in shore as far as can be got while the flood tide lasts. The ropes are then hauled in as the tide ebbs, and this operation is repeated every tide until the vesel is got far enough inshore for the water to fall below the level of the deck, any holes are then closed up, she is pumped out and refloated. It is obvious that the distance the vessel can be raised and towed inshore each tide by this arrangement depends on the range of the tide in the locality of the wreck and the slope of the bottom. When the pontoons are efficiently subdivided and provided with pumps the operation is greatly facilitated by flooding and sinking them as low in the water as it is compatible with safety, then after making fast the ropes they are pumped out, and the lift is increased by the difference due to the sinking of the pontoons. The greatest objections that can be offered against this system is the length of time required, and the danger of bad weather occurring after the ropes are fast, and causing damage to the pontoons.

The second method mentioned that of pumping, consists of closing up all openings in the submerged structure, introducing suction pipes, and pumping out the water by means of powerful pumps. It is only applicable to vessels lying in comparatively shallow water as the strains set up by the superincumbent water when the interior is pumped out may cause the decks to collapse. If the ship founders in a light condition the divers can get inside and shore up the decks so that they will stand considerable pressure, but even then, the depth at which the operation may be carried out is limited to the lift of the pump.

Much ingenuity and constructive skill is often displayed by marine salvors in closing up the openings on deck and holes caused by damage to a ship. In the case of a ship sunk by collision having a large rent in the side a template is generally made to fit the side round the damaged portion, the patch or shield is then got ready at the surface, sunk into position, and attached by tee-head or hook bolts to the hull. Plenty of hair felt is employed so that on screwing up the patch to the ship's side the joint will be as watertight as possible. In several cases a plate large enough to cover the hole has been fitted round the rim with a channel iron, into this channel was packed an india-rubber hose, capable of standing considerable pressure, and when the shield had been attached in its place water was forced into the hose causing it to swell and fill all irregularities between the shield and the skin of the vessel, thus forming a very efficient joint.

In closing up deck hatches, etc., a very strong job must be made, as the strain on them is considerable, when the pumps have started. A hatch 20 ft. by 12 ft., at a depth of 10 ft. below the surface, would have distributed over its area a weight of 68½ tons. Air pipes have to be fitted to each compartment so that the atmospheric pressure may be admitted to the surface of the water inside the ship. The pumps almost universally adopted by salvage engineers are of the direct-driven centrifugal type. They occupy less space and can raise a larger quantity of water in less time, and at smaller cost than any other kind of pump. Their principal recommendation from a salvor's point of view is the absence of all valves and contracted passages which are liable to choke at the most critical times. They will pass pieces of coal, wedges, and stuff which would at once choke any other kind of pump, and being provided with hand holes can be very quickly cleared. The metal suction pipes are generally provided with telescopic lengths, and flexible pipes made of leather or india-rubber strengthened with coiled wire are frequently used.

The vertical pumps and steam-driven pumps have now been to a large extent abandoned in favor of centrifugal pumps driven by oil engines. As the pumps have frequently to be lifted into very awkward positions, the machine having motor and pumps all on one bedplate is much easier handled. The lift of a centrifugal pump, however, is a comparatively limited one, being under ordinary practical conditions about 20 ft. One of the greatest advances with regard to pumps for salvage work is undoubtedly the "Submersible Motor Pump." For many years, efforts have been made to enclose electric motors with different types of casings so as to make them watertight and airtight, and the result has always been failure, as the heat generated sets up condensation and destroys the insulation. The submersible motors made under the Macdonald Patents have, however, effected a revolution in this respect as the windings are insulated by a new process to stand continuous immersion in water. Its great feature is that it only needs enclosing to keep floating debris from the working parts, but allows water to circulate through it internally. There are no glands or other details which are likely to give trouble, and they will start submerged without the slightest hitch or trouble. The submersible motor in combination with a suitable centrifugal pump opens up possibilities such as have never hitherto been contemplated. It can be lowered down to any deck below water, placed in position by the diver, and worked from the generators on the salvage steamer either alongside or from any distance away. In many cases it is only necessary to suspend the pumps from the steamer's derricks and lower them into the water without coupling up any suctions. Pumping can be commenced immediately after one length of delivery hose is attached, the whole operation being carried out very quickly.

When the depth at which the wreck lies is so great that the deck will not stand the pressure due to the head of water over it, a plan commonly known among salvors as "stanking" is adopted. The word "stanking" is derived probably from the old sea term "to staunch" or "staunching," and it means, in the wreckers' terminology the construction of a coffer-dam or trunk on a sunken vessel. It is in fact a continuation of the vessel's sides to above the surface of the water. Heavy logs of timber are secured along the sides or to the decks. From these logs a strong framework is erected and very efficiently stayed with diagonal shores from the centre of the deck, and opposite gunwales. This frame-work is then planked vertically with strong planks, the edges of which may be half checked in the manner known as ship-lap. Platforms for the pumping plant are fitted and the water is then pumped from the interior of the erection. As the vessel gradually rises she is towed inshore to shallow water, the superstructure is then removed, and the pumps are placed on deck. This method has been adopted with successful results in the case of several very large vessels. It is, however, an operation at once tedious and risky, the cost depending greatly upon the nature of the weather experienced while conducting it.

The third method mentioned, that of air pressure, is one which is yet not generally practised in connection with wreck raising. It has been successfully adopted in several cases but the majority of salvors seem to look upon it unfavorably. Generally speaking it is a case of treating the submerged ship as if she were a huge diving bell, driving compressed air into the interior and forcing the water out. All openings in the compartments into which air is to be forced have to be very efficiently secured. In some cases very strong wooden box-shaped caissons were fitted over the hatchways and fastened to the deck; to these, air locks were attached, by which men descended into the hold of the submerged vessel and effected some repairs. Large discharge pipes with non-return valves have to be fitted far enough below the deck to get the buoyancy required to raise the vessel. It is also necessary to fit escape valves for relieving the pressure as the vessel rises to the surface. The principal objection that can be offered against this system is the great difficulty of closing up the deck openings sufficiently airtight to obtain the pressure required.

A modification of this air-pressure system has been tried by introducing specially-prepared canvas bags under the decks and forcing air into the bags until sufficient displacement is obtained to lift the weight of the vessel.

The most practical method of employing compressed air for the lifting of submerged vessels would be to have specially-constructed pontoons, which could be sunk alongside the wreck. These pontoons would have to be constructed with a longitudinal well in the center and efficiently subdivided, or vertical tubes might be fitted between the keel plate and deck at longitudinal intervals. The lifting ropes being brought up through the center of buoyancy of the pontoons they would be in stable equilibrium when taking the lift.

The objection raised by most marine salvors to the employment of submerged pontoons is that it is impossible for divers working underneath the surface to take in the lifting ropes and make them fast, so that each is bearing its proper proportion of the weight. However, the method possesses the following great advantages over ordinary surface pontooning.

(1) On arrival at the position of the wreck the submersible pontoons could be sunk at any time, and so escape any damage likely to happen through bad weather.

(2) Specially built pontoons of this kind could be blown out and exercise their lifting capacity at depths where pumping would be impracticable.

(3) The wreck could be raised to the surface in one lift and towed direct to a safe beach.

We will now consider another class of wreck with which many of you are no doubt more familiar, that of the stranded ship driven ashore by a gale, or may be, after vainly fighting against the storm she is run ashore to escape a worse fate. Some of the most varied and interesting marine salvage operations ever carried out, have been done in the refloating of stranded vessels. The method adopted will depend on the position of the wreck, the extent of the damage, and the depth of water at high tide. Take the common case of a vessel ashore on a reef, her bottom penetrated and admitting water freely to several compartments. Being embedded on the rocks it will be impossible to patch up the holes from the outside. When the vessel has a double bottom throughout, the damage will probably be confined to the outside plating; should the double bottom inner plating be started it is comparatively easy to fix that water-tight.

If, however, the vessel is constructed with ordinary floors, that is without a double-bottom, the problem is very much complicated. When the perforations in the bottom are few and not very large it is usual to deposit a mound of cement reinforced with strips of thin steel over each. In a case of this kind, however, if the bottom is very badly damaged the plan generally adopted is known as "platforming," and consists of fitting inside the vessel a platform or deck of timber low enough in the ship to cut off the necessary buoyancy. Timber beams having been taken inside in two lengths and bolted together in a position, a deck of 11 by 3 planks is then laid, roughly caulked, and shored down from the deck above. A sump or well must be provided at the lowest part in each compartment for placing the end of the suction pipe in, and it is also necessary to fit a small air hatch, about 30 in. square at the highest part, to allow the air to escape from underneath as the tide rises. This hatch also serves another useful purpose; when the platform is completed and the attempt to refloat is to be made it is kept open until the rising water is just about lipping over. The cover is then put on and secured with a tricker shore, so that if anything goes wrong and it becomes necessary to scuttle the ship this shore can be easily knocked out, and she will sink back on her old bed, so damaging her bottom as little as possible. As there is always considerable difficulty in making a platform watertight, it is usual to provide pumps capable of dealing with a large inflow of water.

Cases have occurred where vessels have gone stem on to the rocks, the serious damage being confined to the fore-end, and it has been found expedient to cut away the damaged fore-part, refloat the remainder of the vessel, and having towed her stern first to the nearest port a new fore-end has been built on.

A vessel stranded on rocks is in a bad enough predicament, but it may surprise you to learn that a ship ashore on a sandy beach is often in a much worse plight. Probably, by force of heavy seas, driven so far up the beach that there is not sufficient depth of water to float her, she may have sunk some distance in the sand, and in that case will have to be raised with powerful hydraulic jacks, launching ways introduced under her, and shipped out to deep water on these. Cases have also occurred where a channel has been dug, lined with sand-bags to keep it from falling in, and the vessel worked down gradually to deep water in this manner.

In the conduct of "marine salvage operations" the qualities of resource, energy, and engineering skill are required in a high degree, and I think it is a matter for regret that we have not, at the present time, more and better-equipped salvage companies in this country.

Cytology—II.*

Its Methods and Their Value

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THE mitochondria have also occasioned vital observations which leave no room for doubt as to their reality. But such observations can rarely be made upon the animal cell. We are indebted to Lewitsky[1] and to Maximow[2] for vital observations on the chondriome of various Pharerogams and the transformation of the mitochondria into chloroplasts. But this subject has been best demonstrated by our own observations in the last few years. Some of these show the conclusions which can be drawn from the vital study of cells, and the reality of the mitochondria.

We have proved that amidon is the product of the mitochondria, but sometimes it is found in the comparatively large corpuscles which result from the differentiation of the mitochondria and which correspond to the amyloplasts of W. Schimper, and sometimes it is formed directly in the mitochondria. An example of the latter is found in the root of the castor oil plant (*Ricinus*). In the cells of the *meristem* of this root (Fig. 8), it is easy to show by the mitochondrial method numerous chondriacontia which form on their course small grains of compound amidon, appearing as small colorless vacuoles. By treating with iodo-iodide of potassium preparations obtained by Regaud's methods we have shown that these vacuoles then assume the mahogany brown color characteristic of dextrine in the heart of the mitochondria, while the latter retain their deep black color due to hematoxylin, thus showing that amidon is formed in the mitochondria. However, the cells of the *meristem* of Ricinus root are very small with a very dense cytoplasm which forbids control by vital observation; hence, it might possibly be objected that the mitochondria resulted from the method of preparation . . ., but we shall see that there is an indirect means of proving the reality of our observations.

Our later observations have shown that the flower of the *Iris Germanica*[3] is one of the most valuable subjects for the study of the chondriome.

If for example, we examine the epidermis of the sepals of a young flower, we easily perceive within each cell the nucleus with its nucleolus, the cytoplasm enclosing several vacuoles and a very large number of mitochondria. The transparency of the cells is such that in many cases it even enables us to perceive various stages of the karyokinesis which is frequent at this point. The chondriome is outlined with admirable clearness, and appears to be formed especially by numerous chondriocontia (*ch.*), which are slender, flexible, much elongated, and sometimes branched (Fig. 9, *1*). These elements are scattered throughout the whole cell but by preference around the nucleus.

At a later stage (Fig. 9, *2* to *5*), we see formed upon the course of the chondriocontia small, brilliant granules[4]. (*gr. a.*), which represent amidon which can be colored by iodo-iodide of potassium without altering the chondriocontia. These granules are either simple or compound. Thus this vital observation enables us to control the results obtained by the mitochondrial methods and to give to these results the rigorous precision of an experimental demonstration. Here we achieve the crucial test of Bacon. Plants are rich in examples of this sort. They also enable us, by indirect means, to solve certain problems which animal Cytology, more complex, cannot solve definitely for lack of vital observations. We quote below several examples, likewise borrowed from our own researches:

Certain cytologists have thought that they perceived in the animal cell fat globules being formed in the interior of the mitochondria, but they have not been able to support these facts by an absolutely rigorous demonstration. Such a demonstration is given by mere vital observation in plant Cytology. It seems therefore more than probable that the process is the same in animal cells.

Let us observe, for example, the membraneous bracts which cover the flowers of the *Iris Germanica* before their blossoming (Fig. 10). We perceive that all the cells of the epidermis show numerous chondriocontia, which produce upon their course very small globules which are clearly detached by reason of their brilliance from the chondriocontia, which is more transparent and of softer tone (*g. gr.*). These globules present the characteristics of neutral fats. By mounting the preparation in a drop of one per cent. osmic acid solution we perceive that all these globules gradually turn brown. They are also colored by Sudan III, Nile blue, dissolving in the solvents of fats. These observations lend very great probability to the view that in the plant cell fat globules are formed within the mitochondria.

Another Example: The question of the origin of the pigments of animal cells has been much discussed in recent years. Following the researches of Policard, Mulon, Prenant, Aswadourova,[5] and Luna,[6] it has been believed that the pigments of animal cells have a mitochondrial origin. This opinion is based on the following facts: Within the cells where the pigments are formed both mitochondria and pigmentary granules can be observed at the same time, but the pigmentary granules have the same form as the mitochondria. If, for example, the chondriome presents itself in the form of granular mitochondria, the pigment assumes the form of little granules. Inversely, if the chondriome is represented by the chondriocontia then the pigment appears in the shape of rods of the same form as the chondriocontia (Fig. 15). Finally, when the formation of the pigment is finished we no longer find any mitochondria in the cells; these elements have been replaced by numerous pigmentary granules. Hence the conclusion that the pigment is formed inside the mitochondria. This opinion is the more probable since in the plant cell, as has long been known through the researches of W. Schimper, Arthur Meyer, and Courchet, the pigments are the product of the activity of special organic bodies, analogous to the chloroplasts and to the amyloplasts and called *chromoplasts*. Here too the vital observation of the formation of the pigments in the flower of the *Iris Germanica* gives indisputable proof of a fact which animal Cytology has never been able to demonstrate by mitochondrial methods with absolute certainty.

There are in the sepals and petals of the flower of the *Iris Germanica* various areas of yellow tint. If we detach a fragment of the epidermis which contains this pigment belonging to the xanthophyl group, it is easy to follow in the living specimen all the stages of its formation inside of the mitochondria. In the very young cells, before the beginning of the pigmentation the chondriome is composed of numerous chondriocontia. At a later stage, at the moment when the flower begins to be pigmented, the chondriocontia become impregnated with xanthophyl; they take on a pale yellow color which becomes deeper little by little. A little later, when the flower has reached a certain degree of development (Fig. 11, *1* and *2*), they form upon their course small struma or swellings which are the origin of the chromoplasts described by Schimper, Meyer and Courchet. These struma are formed either at the extremities of the chondriocontia, which then assume the aspect of *halteres*, or in the interior of these elements, which become spindle-shaped. The struma thus formed increase in size and finally separate from the chondriocontia which gave them birth by reabsorption of the tapering portion of the latter; they then become larger and present themselves in the form of large rounded corpuscles (Fig. 11, *3*), analogous to the cromoplasts, which have long been familiar in plants.

In other flowers, such as the flower of the gladiolus of Nancy, the pigment is formed in the chondriocontia as in the preceding, but these elements remain in this state and are never transformed into true chromoplasts (Fig. 12). Thus we have here the same case as observed in the animal cell.

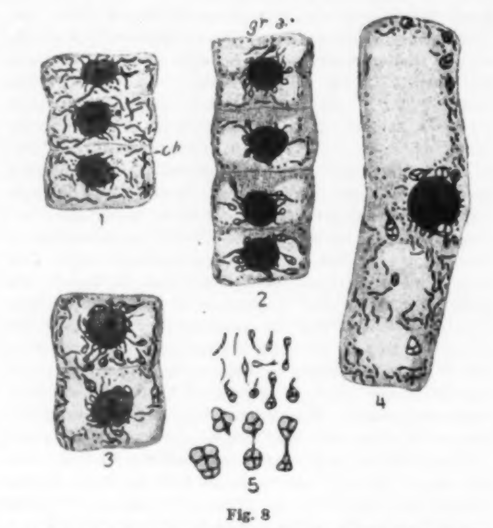

Fig. 8

Fig. 8.—Cells of the root of Ricinus examined after fixation and staining by Regaud's mitrochondrial methods. 1, young cell of the non-differentiated part of the meristem. The cytoplasm is filled with mitochondria, especially represented by the chondriocontia (*ch.*). 2, 3, 4, cells of the part of the root where the meristem is differentiated into parenchymatous cells. The chondriocontia form on their course grains of amidon (*gr. a.*) appearing within the mitochondrial substance as small colorless vacuoles. 5, successive stages of formation of grains of amidon within the chondriocontia.

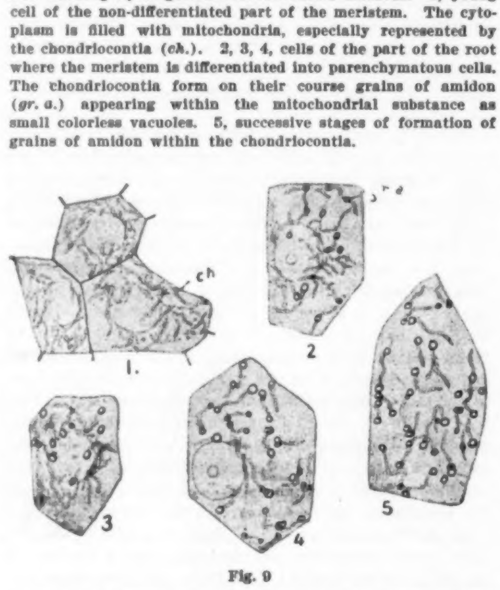

Fig. 9

Fig. 9.—Epdermic cells of a sepal of the flower of the Iris Germanica examined in living specimen. 1, cells of a very young flower showing their nucleus and their chondriome, the latter especially represented by the chondriocontia (*ch.*), 2 to 5, cells of an older flower. The chondriocontia form on their course small, simple or compound grains of starch (*gr. a.*).

Fig. 10

Fig. 10.—Epidermic cells of a bract of the flower of the Iris Germanica observed in a drop of one per cent. osmic acid solution. 1, the chondriocontia (*ch.*) form on their course fat globules (*g. gr.*) which are turned brown by osmic acid. 2, various stages of elaboration of fat globules.

*Translated for the SCIENTIFIC AMERICAN SUPPLEMENT from *Revue Generale des Sciences* (Paris).

[1] Lewitsky: The Chloroplast Conditions of Living and of Fixed Cells. Reports of German Botanical Society II, 1912. The Comparative Investigation of Chondriosomes in Fixed and in Living Plant Cells. Ibid., 1912.

[2] Maximow: The Chondriome in Living Plant Cells, *Anat. Anzeiger*, 1912.

[3] Guilliermond: Vital Study of Chondriome of Sepals and Petals of Flower of *Iris Germanica*. C. R. Soc. de Biologie, 1913. Ibid: New Researches on Chondriome of Flower of *Iris Germanica*. C. R. Soc. de Biol., 1915.

[4] Guilliermond: Upon the Method of Formation of Amidon. C. R. Soc. de Biologie, 1912.

[5] Aswadourova: Researches Upon the Formation of Certain Pigmentary Cells and Pigments. Arch. Anat. Micros., 1913.

[6] Luna: Researches Upon the Biology of the Chondriome. Arch. f. Zellforschung (Cell Study), 1913.

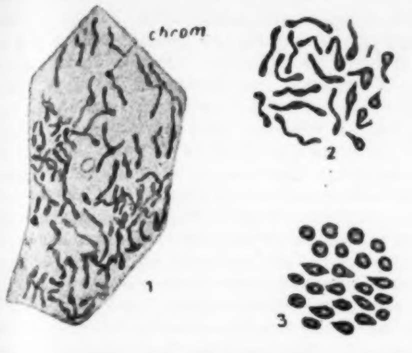

Fig. 11

Fig. 11.—Epidermic cells of sepal of flower of Iris Germanica examined in living specimen. 1, the chondriocontia impregnated with yellow pigment (here gray) form on their course swellings or struma which are destined to become chromoplasts (*chrom.*). 2, successive stages of formation of chromoplasts at expense of the chondriocontia. 3, finished chromoplasts.

Even more: By simple vital observation[7] Guilliermond has enabled us to demonstrate that a whole category of pigments called anthocyanic pigments, to which flowers owe the greater part of their red, blue and violet colors, and which are the cause of the autumnal reddening of leaves, is also the product of the activity of the mitochondria. These pigments, when once formed appear in a dissolved state in the vacuoles, and not in the chromoplasts like the other plant pigments. Hence it had been hitherto thought that they had their origin in the vacuoles.

The young folioles of the Rose contain a red anthocyanus. When examining by chance the epidermic cells of these folioles in the living specimen, we were able to perceive that this pigment had likewise a mitochondrial origin (Fig. 13). It first appeared in the dentations (*dents*) of the very young folioles, and it is possible to find dentations which enable us to follow the evolution of the pigment at every stage: the cells of the point, *i. e.*, the youngest, show the initial stages of the pigmentation, while the cells of the base present its final stages. If we examine one of these dentations we first perceive at the upper extremity colorless cells with numerous chondriocontia. Lower down these elements commence to form anthocyanus and take on a red tint, then they swell at their extremities and change into *halteres* whose two heads finally become separated by reabsorption of the tapering portion which unites them, and assume the form of spherules. These grow larger, then introduce themselves into the vacuoles where they are dissolved, giving to the vacuolar fluid a diffused red color. This is precisely like what had been thought to take place in the presence of a preparation colored artificially.

The study of rose folioles by the mitochondrial method enabled us later to rediscover the same phenomena, and that the more easily since the pigment, being a phenolic compound, with properties similar to those of tannin, was fixed and stained yellow inside the mitochondria by the potassium bichromate used for fixing. These vital observations prove that the mitochondrial methods fix the chondriome and the cytoplasm as well as possible. This is proved beyond controversy by comparisons between vital preparations and those fixed and stained by these methods (Fig. 14). But this is not true of the nucleus, which is often obviously altered . . . The reality of the mitochondria has been hitherto strongly disputed, as was that of karyokinesis formerly. Many authorities have believed that the mitochondria are nothing more than products of alteration of the cell. Others, without denying their existence have denied the claim that they had an elaborative role.

The vital study of the chondriome of the plant cell permits us to solve this question definitely; it gives us irrefutable proof of the reality of the mitochondria, and of the part played by its elements in secretion, since it enables us to perceive, in the living specimen,

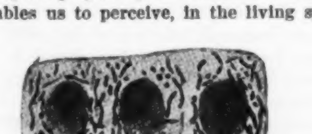

Fig. 15

Fig. 15.—Cells of pigmentary epithelium of a larva of Bufo fixed and stained by mitrochondrial method. They enclose chondriocontia colored black and pigments (here gray) of the same form as the chondriocontia (after Luna).

[7] Cytol. Res. Upon Meth. of Formation of Anthocyanic Pigments. R. Gen. Bot., 1914.

the formation within the mitochondria of granules of amidon, of globules of fat, and of pigments.

We have described these facts in detail because they show in a very real manner that if in many cases the method of fixation may be properly criticized, yet methods exist which fix certain elements of the cell very well, and therefore present all the guarantees necessary, since they give precise results.

The crux of the matter lies in always employing several fixatives, since none of them alone fixes all the elements of the cell, and in always comparing their effects with the results of direct examination. If such examination is often impossible, yet there exist more favorable cells, such as certain plant cells, whose vital study, often very easy, throws light on the more complex problems of animal cytology. In figures 15 and 16 are shown certain aspects of the mitochondria in the process of secreting divers products in the animal cell. These figures, when compared with figures 8 to 14, show strikingly the similarity of the phenomena of animal and plant cells, thus proving that we are right in calling on plant cytology to prove certain more obscure questions in animal cytology.

Fig. 13

Fig. 13.—Cells of dentations of a young foliole of the Rose in which anthocyanic pigment is formed. 1. point of a dentation observed in living specimen. The chondriocontia which are colorless at the top become pigmented in the cells of the lower portion. 2, dentation observed in living specimen nd showing all the successive stages of the formation of pigment. 3, cells of a dentation fixed and stained by Regaud's mitrochondrial method. *a*, young chondriocell chondriocontium; *b*, cells in which a part of the chondriocontia are colored yellow (here gray), because they are impregnated with the pigment, which is colored yellow by bichromate of potassium; *c*, cells in which the chrondriocontia are transformed into large pigmentary spherules.

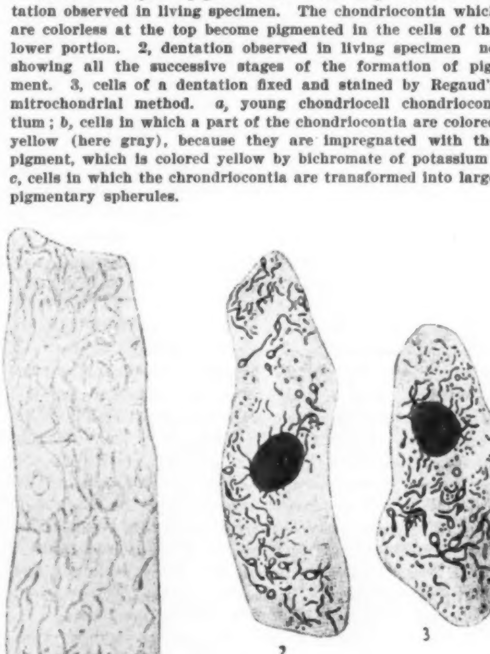

Fig. 14

Fig. 14.—Epidermic cells of the flower of Iris Germanica. 1, examined in living specimen; here we see the chondriocontia in the process of being transformed into inactive leucoplasts. 2, 3, after fixation and staining by Regaud's mitochondrial method. By comparing these two cells with the living cell 1 we are able to perceive that the fixation has admirably preserved the chondriome.

III.

NECESSITY OF GENERAL CYTOLOGY

This shows the value of always making use of general cytology and not confining oneself to either plant or animal cytology alone. The greater part of the problems of cytology can not be cleared up except by general cytology: special cytology is always unproductive . . . It is extremely to be regretted, in fact, that the zoologists and the botanists who specialize in cytology should work separately without making themselves familiar with each other's researches. There are abundant examples of the inconvenience of this. To cite only a few, the majority of zoologists are too often ignorant of the recent researches on the mitochondria of plant cells. Neither have they known, when beginning the study of the mitochondria, anything about the classic researches of W. Schimper, of A. Meyer, etc.; yet these might have furnished valuable clues and opened new horizons. Even to-day they seem to be in ignorance of them.

Fig. 12

Fig. 12.—Cell of epidermis of a petal of the flower of the gladiolus of Nancy observed in living specimens. The chondriocontia are impregnated with yellow pigment (here gray).

Let us mention another example, taken from a different domain. Bacteria contain in abundance granulations such as we have spoken of above in connection with the *Pustularia vesiculosa*, i. e., the metachromatic corpuscles, which we have every reason to regard as reserve products, but whose chemical nature is still unknown. The morphological characteristics, the evolution, and the role of these bodies is now very familiar, thanks to the studies of which they have been the subject in the Algæ, the Fungi, and the protozoa, where they are much easier to observe than in the bacteria, because of the larger size of the cells. Yet the bacteriologists, generally ignorant of the results of studies foreign to their domain, continue to form the most varied and the most untenable hypotheses regarding these very well known bodies—considering them, for example, as grains of chromatin, as products of degeneration, as grains of toxigen, even as internal spores.

IV

THE STAINING

Fixation is, as we have seen, the critical point of the cytologic method. It does not seem to be the same with the second operation, that of staining. It seems probable that if the fixation has been properly managed, the action of the stains cannot greatly modify the cellular structure.

In this second operation it will be advantageous to proceed as in the first, i. e., to study comparatively the action on a cell of a large number of methods of staining, the manner in which we may differentiate, according to their affinities for one stain or another, the different organic bodies or products of the cell. This manner of proceeding will have the advantage of completing the cytologic analysis begun by the method of convergent fixations, and of characterizing certain products of the elaboration of the cell, or certain organic bodies, by the manner in which they behave as regards the series of stains.

There are no specific stains for any given organic body or product of the cell, e. g., there is no known specific stain for the nucleus, the cytoplasm, or the chondriome, which would enable us to characterize

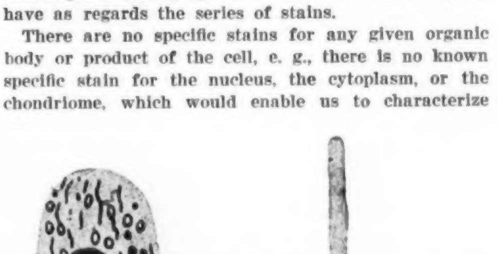

Fig. 16

Fig. 16.—1, Renal cells of a larva of Amphibian during secretion, fixed and stained by mitrochondrial method. Certain chondriocontia form on their course vesicles entirely comparable to those in which amidon is elaborated in plants (after Luna). 2, diagram representing formation of fat globules in the adipose cells (after Dubreuil).

these constituents of the cell. Such characterization is only possible by basing it upon the ensemble of the morphological characteristics and of the characteristics shown by fixation and staining. If there is entire concordance between the organic bodies or products of two cells belonging to different organisms, then it is fair to conclude that they are identical. For example, the mitochondria of plants present the same forms, develop in the same manner, and show the same characteristics of fixation and staining as those of animal cells. Hence we cannot doubt their identity. In the same way the metachromatic corpuscles of the Fungi present the same characteristics as those of the Bacteria, hence they may be considered similar products. It was by this means that Mangin succeeded in characterizing the various substances which enter into the composition of plant membranes.

Here a very delicate question presents itself. Is it legitimate to rely upon the resemblances which may be presented, in different cells, by two series of bodies which are distinguished from each other in certain respects, to establish a similarity between them?

Let us make this more definite by an example. The metachromatic corpuscles have the property of being metachromatically stained a wine red color by the blue or violet basic tinctures of aniline. A similar metachromasia is in no way specific for these bodies since it is very frequently observed in bodies of highly different chemical nature. Hence it is, taken alone, an insufficient characterization. But this property is accompanied by a great number of others. Thus, the metachromatic corpuscles are stained in the living specimen by neutral red, Nile blue, methylene blue, etc.; they are colored selectively by ruthenium red, are tinted metachromatically by hematin, and are not well preserved except after fixation by alcohol, sublimate, or formol. Finally, their form and their evolution are the same in all the cells where they are found. This whole ensemble of characteristics, derived from the morphology and the physiology, from the fixation and the staining, suffices to characterize these bodies.

In certain leucocytes (*Mastzellen*) there are granulations which appear to offer the whole ensemble of the above characteristics, with the single exception that they are not stained by hematin. In spite of this may we approximate these two categories of bodies and consider them as of nearly similar substance?

We do not hesitate to say yes, and it seems probable that we may be able to establish relationships between the various categories of inclusions found in the cells according to resemblances in their fixation and staining characteristics.

However, this will require infinite prudence, and such relationships must be regarded merely as very probable hypotheses needing to be verified.

V

HISTOCHEMICAL RESEARCHES

This brings us to a brief consideration of histochemistry. Chemists have reason to look with some suspicion on this science, which consists in the attempt to define certain cellular inclusions by the manner in which they behave with respect to various chemical reagents employed under the microscope; chemists, in fact, put their faith only in macro-chemical analysis. But though microchemistry has only rudimentary measures at its disposal, and its results have thus far been slight, yet the methods of analysis of macrochemistry must also be cautiously employed with regard to the products of the cell; for they do not suffice to give precise information as to the nature of a substance found in combination in a cell except when their results can be controlled by microchemical analysis. If, for example, we wish to make a macrochemical analysis of a substance, we must find a solvent for it and seek the substance to be defined in the resulting solution. But there is no proof that the solvent has not destroyed the combination, or that it has not dissolved at the same time other substances of the cell, which may be possibly confused with the product to be isolated. Hence it is necessary to compare the results of the macrochemical analysis with those of the microchemical analysis.

Some examples may serve to prove that the results of microchemical analysis are far from negligible. Let us cite the interesting researches of Errera[8] upon the glycogen of plants and upon the localization of alkaloids, those of Guignard[9] on the localization of emulsion and of Myrosin, and those of Mangin[10] on the composition of the membrane.

[8] Errera: The Epiplasm of the Ascomycetes and the Glycogen of Plants. *Thesis on Aggregation,* 1882, Brussels. Primary Researches on the Localization and Signification of the Alkaloids in Plants. Bull. Acad. Roy. de Belg., 1887.

[9] Guignard: On the Localization of the Active Principles of the Cruciferae. Journ. de Bot., Vol. IV, 1890.

The interpretation of the results obtained by the method of convergent fixations and the comparative employ of a large number of stains, may, as we have seen, yield certain data as to the chemical nature of certain substances. It was thus that Regaud, Mayer, Schaeffer, and Fauré-Fremiet studied the nature of the mitochondria. They proved the presence of fatty acids in the mitochondria by the affinity of these elements for osmic acid, and the diminution of that affinity by washings with alcohol, ether, etc. They showed that all the specific methods for the mitochondria stain the fatty acids and lecithin.

In our opinion much is to be expected from the perfecting of microchemical processes. We have often had proof that many very interesting and illuminating reactions can be observed under the microscope. Thus it is easy to obtain, on the living cells of the dentations of young folioles of the rose, very precise reactions which prove that the anthocyanic pigments are phenolic compounds presenting certain reactions of tannin. By introducing a drop of the solution of perchloride of iron into a vital preparation wherein every stage of the formation of pigment is represented, we are enabled to observe that the chondriocontia which are beginning to form anthocyanus, gradually acquire the blue-black tint characteristic of certain phenolic compounds. Osmic acid turns them brown, methylene blue stains them vitally. Finally, potassium bichromate fixes them and gives them a beautiful golden yellow tone. A very interesting reaction has been indicated by R. Combes.[11] This is the use of Courtonne's reagent which gives a beautiful green color to anthocyanus. Applied to the folioles of the rose this method enabled us to stain with clear-cut precision the chondriocontia impregnated with anthocyanus, and this without noticeable alteration of the cell.

VI

VALUE OF RESULTS OBTAINED BY CYTOLOGIC METHODS

It remains to consider whether the results thus far obtained in cytology rest on a solid foundation. . . . Cytology began with the study of the nucleus, easier than that of the cytoplasm, because the fixation processes formerly used were more propitious to the conservation of the former, and also because the discovery of karyokinesis, which took place at the beginning of cytological research immediately presented a subject of considerable interest.

The discovery of karyokinesis by Strasburger, Flemming, Guignard, etc., demonstrating that the nucleus transmits integrally the same quantity of chromatin to the two daughter-cells, soon followed by the study by Fol and Guignard of the intimate phenomena of fecundation, immediately gave rise to highly suggestive theories of heredity.

Following on these discoveries, and under the impulse of Weismann's theories, some investigators attributed to chromatin the property of transmitting the hereditary characteristics, and believed that the key to the phenomena of heredity had been found in the chromatic reduction which the gametes undergo, and in the nuclear fusion effected in the egg. It was believed that in the reduction a part of the maternal and paternal characteristics were eliminated, and that in the nuclear fusion there took place the mingling of the remaining characteristics. With this as a starting point a series of hypotheses were made as to the intimate mechanism of this sorting and mingling, which appeared to be the raison d'être of the fecundati n.

These are evidently mere hypotheses, and it seems to us that they have been pursued too far, and have outstripped the facts. There has certainly been too great an ingredient of imagination. It is true these hypotheses fit in very well with the Mendelian laws of heredity, if we accept the qualitative reduction of the chromosomes, as the majority of botanists do, but possibly this is merely a coincidence. In any case it is ill-explained why the nucleus alone should have a monopoly of the phenomena of heredity. Why not admit that the cytoplasm has also a part therein? If it has taken second place up to the present, perhaps this is because its study has been neglected. By a swing of the pendulum, therefore, in recent years an important share in heredity has been attributed to the cytoplasm, and it has been believed, following the ideas of Meves, that the mitochondria also have a share in heredity. Here again we have entirely hypothetical ideas; they are not based on any fact which is sufficiently precise, and for our part we have good reason to believe them inexact. Moreover, it seems very difficult to explain phenomena so complex as heredity by such simple morphological facts.

It is none the less true that the processes of karyokinetic division, the transmission of the chromatin in equal portions to the two daughter-cells in the cellular division, the chromatic reduction during the divisions of reduction and the nuclear fusion of the egg remain definitely ascertained facts, are highly important results whatever their physiological interpretation. They have enabled us to follow nuclear evolution during the development of plants to demonstrate therein an alteration of generations revealing itself by one zametophyte to *n* chromosomes, and one sporophyte to 2*n* chromosomes. This, however, has not shed any light on the question of the physiologic significance of sexuality, which seems to become the more confused the more facts we accumulate. But we can at least hope for future enlightenment.

The study of the cytoplasm has been much neglected, and has given at first the most contradictory results, and also the most erroneous results. It is just here, in fact, that the fixation is most delicate. The cytologists, starting, moreover, from entirely false ideas, have tried to describe a structure of cytoplasm in the same way that a structure of nucleus has been described, although cytoplasm seems to have no definite structure. It sems now to be an accepted view that cytoplasm is a substance in the state of a colloidal complex, does not possess a stable structure, but one which is essentially variable according to conditions.

Opinions as to its structure, also, are very diverse. Some investigators have described an alveolar structure, others a granular structure, others a fillarylar structure. These structures are in reality varied aspects due to the coagulation of the albuminoid matter, and to the alteration of the chondriome by fixation.

A later attempt has been made to describe more precisely the figured elements of the cytoplasm. Prenant and his students have sought to demonstrate the existence of a superior protoplasm, having as its function the elaboration of the secretion products of the cell. It was found necessary later to abandon this conception and admit that the ergastoplasm consists in large part of the alteration figures of the chondriome.

Happily, a series of researches made in recent years has brought to light some exact facts about cytoplasm. As we have seen, recent researches, made by means of a sure technique and controlled by vital observation, demonstrate that there can be distinguished in the cytoplasm:

1. A fundamental substance of ordinary homogeneous aspect, probably in the state of colloidal jelly.
2. Special organic bodies, well defined, the mitochondria. But up to the present the methods of fixation employed did not enable us to obtain the differentiation of these essential elements of the cytoplasm. They all dissolved a portion of the cell, the lipoids, which are always present in the cytoplasm in considerable quantity, and it is known that the mitochondria seem to be constituted by lipoproteids, which, consequently were dissolved or altered by the fixatives. It was necessary to employ special methods . . . to obtain this differentiation, and the results obtained by these opened large horizons by assimilating the mitochondria to the plastids of plants, and proving that these organic bodies are one of the indispensable constituents of the cell, and have a very general role. It has now been proven that most of the products elaborated in the cell are formed in the interior of the mitochondria, but by what mechanism we are still ignorant. Very suggestive hypotheses on this theme have already been made, and it invites research. These results throw much light on cellular physiology and the mechanism of secretion. And these results are quite impeccable, since controlled with precision by vital observation. The discovery of the chondriome and its physiologic function, is, with that of karyokinesis, the most certain and the most important acquisition of cytology.

Cytology tends increasingly to direct itself towards cell physiology and histochemistry, and is thereby destined, doubtless, to become one of the valuable auxiliaries of general physiology. . . . In this new orientation, the only one really desirable, since morphological facts have no value except in relation to phenomena, we may believe that cytology has a brilliant future.

The comparative observations of the fixed and the living cell, of which we have just made an exposition, have demonstrated that good fixations reproduce on the whole the structure of the latter quite faithfully. It is thus that the reality of the karyokinetic and mitochondrial figures have been observed in the living cell. The cytologic methods, therefore, are able to lead to exact results of the experimental order. Cytology, in fact, has made considerable progress of late years and helped to throw new light on cellular physiology.

[10] Mangin: Anatomical Researches on the Distribution of Pectic Compounds in Plants. Journ. de Bot., 1891 to 1893.

[11] R. Combes: Comptes Rendus. Acad. Fr. des Sciences (Minutes of French Acad. of Sciences).

The Modern Whale Oil Industry

Historical Notes and Methods of Production

By William Mansbridge

The whaling industry has, from one cause or another, experienced many fluctuations of prosperity and vicissitude, now a flourishing industry, then after a few decades not worth pursuing. Hull, Dundee, Glasgow, and the seaport towns of the Eastern States of America, all had their period of supremacy, and now Tonsberg and Sandfjord in Norway occupy the first place as headquarters for fitting out whaling expeditions.

Just previous to 1868 whaling as an industry had languished, was in fact moribund; true, the pursuit of the Greenland whale and the sperm whale, as yielding the most valuable products, was still carried on, but as a whole the industry had reached such a point that it would soon have ceased to have had any particular importance as a source of oil.

This state of affairs was the result of a variety of circumstances. The increasing difficulty of the chase owing to the disappearance of the animals from their usual haunts, the increasing rarity of the two kinds chiefly sought, the fact of the hand harpoon having reached its limit as an effective weapon, and the great development of the mineral oil industry introducing a powerful competitor for purposes of lubrication, all combined to reduce the profits to vanishing point.

In 1868 a Norwegian whaler named Svend Foyn, of Tonsberg, introduced his gun-harpoon and from the start met with great success; the next three or four years were spent in perfecting the new weapon. Modern whaling dates from this event and soon Svend Foyn by his captures in the Varanger Fiords had demonstrated the efficiency of his methods and that whales could still be caught in numbers on the coast of Norway, the powerful sulphur-bottom and less valuable finback and humpback could now be taken and made to pay. In 1877 a competing company appeared and by 1886 there were nineteen companies with 35 whaling ships engaged in the waters adjacent to the Norwegian coasts. Coincident with the gun harpoon came the use of steam vessels; the harpoon weighing 4—5 cwt. and its heavy gun required a steady platform and a fairly large boat. Operations at this period were conducted from land stations where the captured whales were taken to be stripped of their blubber; thus the old-time whaling ship with its complement of oar-propelled boats for chasing was superseded, at any rate for this kind of work.

But this prosperity was not without interruption; the cod fishermen and others, believing that the operations of the whaling fleet damaged their industry, sought and obtained a law prohibiting whaling on the coasts of Norway and in consequence the business suffered a serious setback.

During the period 1868-1904, 17,745 whales were taken on the Norwegian coasts, the best year being 1885 with 1,287 captures. In the earlier part of this time the blubber alone was utilized but, as it was realized that whales were becoming scarcer, other uses for the whale carcass were sought, the result being that the land stations began to make bone meal and whale guano from the parts usually thrown away.

In 1894 whalers began to visit the Faroe Islands with success, and eventually there were 6 stations with 13 to 17 whaling ships having their headquarters in the islands. Fishing in narrow seas as in Irish and Scottish waters was not very productive, although the one or two companies operating there still do very well. At the opening of the twentieth century we find the Norwegians extending their methods to Newfoundland, Iceland, and Spitzbergen with considerable success.

In 1904-05 it was discovered that the South Pacific and South Atlantic were frequented by whales in immense numbers, land stations were established in South Georgia, the South Shetlands, the Falkland Islands, and Kerguelen, and at the present time these waters supply 80—90% of the whale oil production of the world.

The floating factory now becomes necessary to the economical development of the industry; it is the modern counterpart of the old-time whaling ship, but the fires, fed with exhausted blubber, have given place to steam and the open "try-pots" to "press cookers," while on the floating factories the oil when ready is run into tanks and brought home in bulk instead of in casks.

The vast distances in the Southern oceans make such an arrangement of primary importance, and the employment of a floating factory is, in its effect, as important and far-reaching as the earlier influence of the gun-harpoon; it allows the chase to be carried right up to the edge of the Antarctic ice where the natural difficulties of maintaining a land station are practically insurmountable, and besides saves much time by following up the fishing fleet.

The usual method of working such distant waters as the South Pacific and the South Atlantic is for the floating factory to sail with supplies for the land stations towards the end of summer. This cargo consists of coal, provisions, building material, machinery and general stores, including empty barrels, the coal being carried in the oil tanks. After discharging at say South Georgia, the tanks are cleaned out ready for oil and the factory ship, accompanied by its fleet of fishing vessels, departs for the cruising ground which may be at the edge of the Antarctic ice. The actual pursuit and killing of the whale is done by small steamers of about 120 tons; the gun is mounted in the bows and naturally the skill of the gunner is an important matter. On sighting a whale the vessel is allowed to drift near enough to the animal as it rises to blow within range, the harpoon is fired into it, out goes the thick cable, and if the shot has been a good one the whale is soon alongside, wound in by the steam winch and inflated through a hollow lance to make it float easily; as many as four may be secured in this way and taken to the floating factory on to the land station for disposal. The bomb harpoon, frequently employed, has an explosive head fired by a time fuse and if well planted in the whale death quickly ensues.

The floating factory is often an old liner filled with tanks for the reception of the oil; even the ballast tanks are utilized for the same purpose; some have a few large tanks built into them, others have as many as 80 or 90 small tanks; barrels from the land stations are carried in the 'tween decks, and the upper deck amidships is occupied by the "cooker tanks," as the digesters in which the blubber is rendered or "tried out" are called. The cooker tanks are arranged in pairs; they are strong iron vessels capable of standing a pressure of 100 lb. per square inch, with a wide manhole at the top for charging and one near the bottom for discharging the exhausted blubber, and perhaps one pair will be fitted with extra large openings 4 feet diameter for the reception of bones, such as ribs and vertebræ; curved iron plates are used to provide a free passage for the steam through the mass of blubber.

Arrived alongside the operation of "flensing," which consists in stripping the blubber from the dead whale, is at once commenced; huge pieces are hoisted on board, put through the chopping machine, taken up by an elevator and dropped into the cooker, steam is turned on, and after a sufficient period, generally six to eight hours, the oil is run off through a system of separating tanks to get rid of the free water, then into the store tanks in the lower part of the ship.

The process of cooking is of very great importance; upon the skill and care with which it is conducted depends whether the oil will reach the market in good condition or much depreciated in value, hence the cook shares with the gunner the honors of a successful voyage. As the largest number of cargoes arrive during March to July it follows that a large part of the season's oil is upwards of six months old, and it may even be eighteen months old when marketed, so that unless properly cooked it will keep badly and in consequence fetch a lower price when landed. The ambition of most cooks is to produce a very pale oil; this is not an easy matter even from very fresh whales if the oil is well cooked, but unfortunately quite simple if undercooked. I have been informed that cold pressing with hydraulic presses has been tried with the object of obtaining a very pale colored oil, but, as might be expected, the oil quickly became rancid and bad in other ways, and the idea was soon abandoned. The best cook is one who is able to get the largest yield of pale oil with the best keeping qualities; this also best fills the requirements of both parties, the producer of the oil and the merchant who buys it from him. It has always been my advice to the captains of floating factories to make a well cooked oil that will grade "No. 1" and let the superfine color go, because if stored it always depreciates and falls to No. 1 standard or lower; they generally see the force of this, particularly as nowadays they do not get a premium for extra pale oil.

From the point of view of oil production the most valuable whale is the sulphur-bottom, *Balaenoptera sibbaldii*, Gray (*sulphureus*, Cope), which belongs to the class called rorquals and known as "Finners;" but if other products are taken into account the Greenland Right whale, *Balaena mysticetus*, is easily first, because of the value of the whalebone obtained from its mouth, with the Sperm whale, *Physeter macrocephalus*, L., which furnishes spermaceti and is also the source of the very valuable substance known as ambergris, a good second. The sulphur-bottom whale is considered to be the largest known animal, either living or extinct, of the earth; it often attains a length of 90 feet with a yield of 100 barrels of oil, the record being taken by an authentic specimen measuring 96 feet in length which gave 140 barrels of oil. The "bone" obtained from this species is harsh and brittle and, compared with true whalebone, of little value, since it only fetches £35 to £45 or even less per ton, according to condition, whereas that furnished by the Right whale brings about £2,500 per ton at the present day. The "bone" from the different species of rorqual is known as "finners," which term is also extended to the animal that bears it. The humpback, *Megaptera longimanus*, Rudolphi, abounds in Southern waters and is taken up to 50 feet in length; it gives 25-40 barrels of oil, while the finback, the gamest and most sporting of whales, grows to 70 feet but is also poor in oil, yielding 25-45 barrels. The bottlenose whale, *Hyperodon rostratum*, Miller, is chiefly hunted in the North Atlantic, the oil being very similar in constitution to that of the sperm whale; the animal is only of middle size, attaining a length of 20-30 feet, but gregarious in herds of about a dozen it well repays the chase. Altogether there are upwards of seventy kinds of whales, but many of them are considered by authorities to be only varieties or geographical races of predominant species.

I have often heard the opinion expressed that if they go on killing whales at the present rate, it will not be long before the industry must again suffer a decline and be scarcely worth following. In order to obtain information on this point I have made many inquiries from captains regarding the length of time occupied in growth; most replies have been to the effect that they do not know, but the best opinion indicates that whales grow very rapidly. As one captain who had given much thought to the matter, referring to the humpback, put it, the calf just before birth is about 16 feet long and when weaned some two months later is about 24 feet in length, so that when two years old the whale might very well be full grown or nearly so. If this opinion be correct, and I do not doubt it myself seeing that all the conditions of the environment are conducive to rapid growth, viz., abundance of food, warm water in the breeding grounds, and with few enemies powerful enough to do much injury combined with a fairly rapid rate of natural increase, it will be a long time, even at the present rate, before whales will be perceptibly diminished in numbers. This view is supported by the figures for 1911, as in that year we find that after 35 seasons of modern hunting in European water 1,165 whales were taken, yielding an average of 35 barrels of oil per whale; in the same year the Southern Norwegian catch in the south seas is recorded as 12,635 whales, giving 306,000 barrels of oil, or an average of nearly 25 barrels for the Norwegian catch in those waters. I think the above figures sufficiently indicate that we may expect a good supply of whale oil for many years to come; this is the more gratifying in view of the importance of the industrial applications of the oil, especially during the last few years.

As illustrating the magnitude of the fleet of vessels engaged in whaling in 1912, there were:

Fifty-four floating factories of 155,174 tons total; 9 cargo ships of 21,098 tons total; 267 fishing vessels of 100-120 tons each; a few of the last being 150 tons each.

Some of the floating factories have now been chartered for carrying other kinds of oil, and it is possible that there will be a falling off in the amount of whale oil produced because of this, but I think it will prove to be only temporary.

Crude whale oil is graded according to color, as will have been gathered from the preceding references, but

during the last few years there has been an increasing tendency to make the free fatty acid test a basis of contracts. As a matter of experience it is found that an oil which falls below the highest figure representing the limit of free fatty acid for a particular grade, will also conform to the accepted color standard for that grade; there are exceptions, as for instance, when an oil is discolored by iron salts, but these are rare.

The accepted grades are known as No. 0, No. 1, No. 2, No. 3, and No. 4. No. 0 and No. 1 are now generally classed together, the former being regarded as a superfine No. 1; the color varies from pale straw color to fine pale yellow. No. 2 is amber yellow and No. 3 pale brown, while anything too dark to be classed as No. 3 is regarded as No. 4, unless it is very bad colored when it is referred to as "dark whale oil." In the year 1912 samples representing some 650,000 barrels, or about three-fourths of the entire production for the year, passed through my hands; the color was measured in the Lovibond tintometer and the resulting average was adopted as a standard, which has met the views of both sides of the trade so well that no suggestion for an alteration has been expressed. In conjunction with Mr. J. W. Lovibond a set of standard glasses was prepared and these have proved very useful for the rapid examination of samples so necessary when a large cargo has to be rapidly discharged.

In order to examine crude whale oil in the tintometer it is necessary to warm it slightly in order to melt the stearine; a temperature of 75 to 80 deg. F. is sufficient for the purpose. The oil as delivered by the ship, always contains moisture which should not exceed 0.5 per cent. The sample must not be heated sufficiently to drive off water, and besides, this would probably darken the oil to some extent, neither must filtration be resorted to as thereby color might be removed. Considerable care is therefore needed to obtain accurate results, but a little practice will soon overcome any difficulty in the preparation of the sample.

Modern whale oil is a very different thing from the evil smelling stuff most of us have encountered in our early days; now even the dark colored qualities are not really objectionable, while the pale kinds are quite sweet, possessing no disagreeable taste or smell.

Filipino Silversmiths*

By Elmer S. Green, General Office

The trade of the silversmith is an old one in the Philippines. From the Mountain Province to Mindanao are to be found men skilled "in all manner of workmanship; and to devise curious works, to work in gold, and in silver, and in brass, and in the cutting of stones to set them." Almost every town in the Christian provinces has its "platero" who often lives in the same house and uses the same tools as did his father and grandfather. The members of his own household assist in the simpler and cruder operations, some soldering or assembling parts of chains, others polishing. Work in silver has lately been taken up as an industrial subject in some of the public schools, especially in Bohol. A large assortment of products from that province was exhibited at the Carnival and is now on sale at the retail salesroom in Manila.

Perhaps the largest center of the silversmith's craft is at Bantay, Ilocos Sur, just beyond Vigan. Necklaces and bracelets of gold and silver are made there in great numbers. Long strings of hollow gold beads terminating in pendants, are sold at from 30 to 100 pesos. In each of these at least three forms of beads are combined; the largest number are of simple tube shape, flaring at the center; others are flat and circular, each face bearing a design; the finest are spherical, about 5 millimeters in diameter, and designs are embossed upon them. Sometimes small pearls are alternated with the beads. The pendants are most commonly oval medallions, 2 centimeters or more across the face; in the center of each is a carved gold flower, glass covered on both sides. Crosses are common also, some of most delicate workmanship being ornamented with rows of small leaves, one set above the other. The crucifixes are generally of silver with gold plating. Strands of beads, rather crudely made of silver, then gold washed, are sold at Bantay and in the shops of Vigan for 2 pesos. Many of these are carried to distant provinces for sale by Ilocano traders. These "rosarios" whether cheap or dear are distinctive and beautiful, and it is to be regretted that they are being displaced in favor, except among the more conservative people, by tawdry imported machine made chains.

Rings of low karat gold are often set with clusters of small pearls. Back combs, the visible parts covered with gold and ornamented with raised and usually detachable flowers, the petals of gold, the center of pearl, are sometimes of exquisite workmanship. Brooches and long metal hair pins are similarly decorated with gold and pearl. Earrings are for the most part copies of old-fashioned European models. Among the hoarded treasures of the wealthier people of Vigan are to be seen examples of the workmanship of older days. A style of neck chain now rarely seen is made of small rectangular planchets of gold bordered with filigree work, the chain having the appearance of a narrow strip of lace transformed into gold.

At Bangued in Abra is a silversmith whose work is known and sought throughout the Islands. After the Carnival which just closed, the Bureau of Education bought from him more than 500 pesos worth of goods, chiefly silver mounted camagon canes and boars' tusks, for disposal at the retail salesroom. At Baguio and Trinidad there are half a dozen Ilocanos who make spoons and "Igorot" earrings for the tourist trade. The spoons have twisted handles and terminate in figures of Igorots, rather too elaborate. If one has the confidence of a silversmith and asks his opinion, he will explain that the highly ornamental stuff is not artistic; that he makes it to sell, and not because he considers it beautiful.

The fine jewelry of a hundred years ago was made from Spanish gold coins without additional alloys. Now American five and ten-dollar pieces are used, and they command a slight premium in the provinces. At Bantay, some of the work is done with "sea gold," dust which a few of the inhabitants of San Vicente laboriously wash from the black sands which the Abra River brings to the coast. For the making of beads, a mixture of two parts of gold to one of silver is ordinarily employed, the unfinished article appearing very white. For rings and earrings copper is added, the resulting alloy being extremely red. The beads are colored by placing them in a saucer with a gold coin. An acid solution is poured over beads and coin and after a time the beads take the desired color.

In silver there are made spoons, key rings, knobs for canes, and an infinite variety of pieces to order. These articles are rough cast into the general form desired, then beaten and filed into shape. The price is fixed in accordance with the amount of metal used: as much for the work as for the silver. The silver is secured from obsolete coins. Mexican dollars, Spanish "pieces of eight," so old that they might have been pirates' treasure, and later pieces bearing the portraits of Alfonso XII and of Alfonso XIII, all go into the melting pot. The older "Carlos" pieces are preferred, as they are said to be of softer and purer metal.

*The Philippine Craftsman.

Case of So-called "Subconscious Malingering"

In a recent article in The *Lancet* (London) was discussed concussion injuries of the visual apparatus and several interesting cases were cited, among which was the following:

"Private E. F., aged 45, was sniping from the trenches at Zonnebeke one evening in September, 1915, when he was hit on the left side of the head and face by fragments of what he maintains was an explosive bullet, which struck some object only a few inches away from where he was standing. He fell unconscious, and remained in that state for about one hour. On coming round he discovered he was blind in both eyes, and remembers that he noted this at a time when the bandages which covered both eyes were temporarily removed. On about the tenth day after the wound the bandage was permanently taken off the right eye, and he found vision with that eye was normal again. The left eye remained covered with a shade for some more weeks, and when it too was removed he declared he was quite blind in the left eye still, and he has remained so ever since.

"On examination in March, 1917, the left eye was seen to be normal in all respects, with normal pupil reactions. The optic disc was normal and identical in appearance with the right. No defect of any kind was discovered in the nervous system, either organic or "functional." With the double prism and the "friend" tests the patient was completely caught out, and the nature of his visual condition at once demonstrated."

Here, in spite of the general cerebral concussion, unconsciousness, and immediate blindness, the persisting visual defect is clearly seen to be of the nature of so-called "subconscious malingering." Whether the blindness noted at the outset was a concussion phenomenon is questionable, in view of the facts that the patient was not struck on the back of the head, and also that he knew he had been hit in the face and round the left eye, was told there was dirt and sand in both eyes, and remained with both bandaged for some ten days. To exclude the possibility of a peripheral concussion would be more difficult, and it is conceivable we have here a hysterical symptom erected on an existing slight organic basis. The case is quoted to illustrate this difficulty in determining whether a persisting symptom is an original symptom, as well as the further difficulty of assigning relative importance to the more or less synchronous actions of more than one etiological factor."

Solar Ovens

In view of the scarcity of coal or wood in many subtropical regions, such as Egypt, the Punjab, and the Karoo of South Africa, it is interesting to note the report recently made by Sir F. Nicholson, describing, among other things, valuable experiments in the employment of solar ovens. These consist of stout teakwood boxes, blackened inside and fitted with a double glass top. They are suitably insulated, and with this simple apparatus a temperature of from 240° to 275° (Fahr.) is easily obtained during the middle of the day from 11 a. m. to 3 p. m., and 290° with the aid of a single glass mirror. The oven once constructed costs nothing, and for all mere baking or cooking purposes it is a very efficient and cheap utilization of sun heat, suitable for many applications. A summary of the report is given in the *Indian and Eastern Engineer*.

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